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PREFACE.

I THINK it right that I should now, after ten years of extensive experience, lay open to the profession, the results of my labours, upon the very important subjects of which I have treated in the following pages; and more particularly, as I find my improvements and observations have been for sometime greatly garbled, and often, I fear represented, much to the prejudice of those whom they are intended to relieve.

My object has been, to demonstrate, with as much clearness as circumstances would allow, the causes of deformity and non-union which so frequently obtain in cases of fracture managed in the ordinary way, and to point out the means by which these evils might be with facility avoided. In the course of my duty, I have found it necessary to condemn various modes of treatment which are still sanctioned by some of the most scientific surgeons of the time in which we live; but I trust it will be seen that I have never done this from any other than proper motives, *viz.* professional advancement and public good. I have been desirous of maintaining a conscience void of offence towards God and man, and I hope I have stated nothing but what will be found, upon patient investigation, to be the truth, tending to the edification of my readers.

There are some, who, I find, have altered the apparatuses which I have introduced, so as to render them much less efficient. From whatever feeling this may have been done, seeing that much mischief arises in every way from the practice, I deem it expedient to notice it in this place, in order that persons who are injured in consequence, may not ignorantly cast the blame upon me, or the means which I employ.

I have to offer my grateful acknowledgments to those of my professional brethren, who have aided me during my investigations, by placing under my care such cases as tended to illustrate the operations of the contrivances which I have been enabled to introduce. By their kindness, I have had laid open to me a large number of cases, in addition to those which have occurred in my own practice, and by which I have been assisted greatly in proving the importance of my plans. Among those by whom I have been thus favoured, I have had most frequently to notice the names of Mr. Travers and Mr. Green, whose polite attention, I trust, I shall always be able to appreciate as it deserves.

I would advise those who intend to adopt the means which will be found recorded in this Work, to be particular in the choice of the apparatuses that they wish to apply, and also to be careful in the management of them. I am induced to give this caution, because I observe, that some surgeons seem to be very indifferent upon these points, much to their own injury, and often to the injury of those whom they have had to treat. Gentlemen should bear in mind, that the results to which I have arrived, have been obtained by the judicious management of the apparatuses properly constructed, and not by the careless employment of imperfect imitations.

In the execution of my undertaking, I have endeavoured to make my views clear and practical. If it should be thought that I have, in some of the chapters, introduced too many cases, I hope it will be excused, when the importance of the practice which they are intended to illustrate is considered.

I would observe, in this place, that I shall feel very sorry if I have, through inadvertency, justly excited the displeasure of any one. My purpose has been to point out and illustrate what I believe to be the truth. I have attempted to accomplish these objects in a manner which I hope will be found perspicuous, but by no means offensive.

In this Work will be found many improvements, and much important information, for the knowledge of which I desire to give thanks to my Maker, to whom all praise is due.

82, *Great Surry Street,*
October, 1831.

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As I find persons manufacture and sell very imperfect imitations of my apparatuses, from which much mischief has already ensued, I have thought it good to make such arrangements as will enable surgeons to procure them, constructed in every respect according to my directions. To effect this desirable object, I have opened a house, and appointed an agent to attend to the manufacture and sale of every variety of apparatus which I have introduced for the treatment of Fractures. Any net proceeds that may arise from the sale of the apparatuses, will be devoted to charitable purposes. Gentlemen will, therefore, see the propriety of making payment at the time the purchase is effected.

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ON THE

NATURE AND TREATMENT

OF

FRACTURES.

GENERAL OBSERVATIONS ON FRACTURES.

CHAP. I.

NATURE OF FRACTURES—CAUSES, PREDISPOSING AND REMOTE—SYMPTOMS—VARIETIES OF FRACTURE—VARIETIES OF DISPLACEMENT—GENERAL PROGNOSIS.

BY the word fracture, surgeons mean a solution of continuity in a bone, produced by the action of the muscles of the limb, or by external violence. Definition.

The long bones may be fractured at any part; they are, however, more particularly subject to be broken at some distance from the ends.

The causes of fracture may be divided into predisposing and remote. Causes.

Predisposing.

In the first class are comprehended the situation and functions of the bones, the age of the patient, the diseases to which the bones or the system may be subject.

Situation.

Superficial bones are said to be more easily fractured than those that are covered by a considerable quantity of soft parts.

Functions.

The functions of some bones render them more liable to be broken than others:—thus the radius, which supports the hand, is more liable to be fractured than the ulna. The clavicle, which serves to keep the shoulder in its proper position and to support the motions of the upper extremity, is very subject to fracture.

Brittleness.

The bones become brittle in proportion as persons advance in years, and in old age they are sometimes fractured by very slight causes. In childhood they are more elastic and flexible, and are not so easily broken.

Diseases.

Certain diseases predispose to fracture; as syphilis, carcinoma, scorbutus, scrofula. Now and then the bones are so much affected by the venereal virus, that they readily give way under the ordinary action of the muscles of the limb. A person who had a cancer in her breast had her arm broken as she was being handed out of her carriage, and afterwards fractured her thigh as she was changing her posture in bed. There are many instances of the bones breaking under ordinary circumstances, in persons affected with scurvy. Fractures which had been a long time united, have often been known to give way in persons labouring under this disease. Scrofula sometimes so undermines the texture of the bones, that they break with the ordinary action of the muscles. A case of this description I saw a little time back in a delicate young girl who was affected with scrofula. Necrosis may be regarded as a predisposing cause of fracture, an instance of which occurred under my own observation not long since. The patient broke his arm, by the simple effort of raising a shutter.

Cold.

Some surgeons have set down cold as a predisposing cause of fractures. The greater number of falls which happen in Winter are sufficient to explain why fractures are then more common than in Summer. The muscles also, when their tone is increased by the influence of cold, may snap the bones more readily, when the individual puts them suddenly and powerfully into action, in order to save himself from falling, than in the Summer months, when they are supposed to act less vigorously.

Remote causes.

The remote cause of fracture is force variously applied. Falls, blows, &c., are the most common causes. In particular instances the bones are broken by the violent action of the muscles attached to them ; this is almost always the case with the fractured patella. The olecranon and os calcis have likewise been broken by the violent action of the muscles inserted into them.

Action of the muscles.

On the long bones.

Whether the long bones in a healthy state can be fractured by the muscles, has been an unsettled point. But there are now many instances of this on record; and I have met with one myself where the humerus was broken in this way at the neck.

Symptoms of fracture.

Some of the symptoms which are said to indicate the existence of fracture are very uncertain. Crepitus and preternatural motion are the most unequivocal.

Crepitus of effusion.

It is necessary to be on our guard in making our examinations, even if we observe crepitus, for it is not every variety of crepitus that is to be considered diognostic of a fracture. There are several varieties of crepitus which it is well to understand. Some time ago I was requested to see an elderly woman, who fell, six weeks previous, and fractured the upper part of the ulna. The gentleman who had the management of her case felt crepitus when he handled the joint, and this induced him to believe that the fracture was not united. The crepitus he felt, however, was only the crepitus of effusion. The bone was firm, and the woman soon recovered the use of her arm.

Of the joints.

We must be careful that we do not mistake the crepitus which may be occasioned by certain motions of our own joints, or of the patient's, for the crepitus of fracture. A little time back I was in attendance with a surgeon of some celebrity in this town, who was deceived, it appeared to me, by this variety of crepitus, as he was examining the arm of a gentleman who had been confined with a fracture. His attention was directed to the part which had been fractured; and, as he was handling the limb rather firmly, a very audible crack was heard, which he referred to the fracture, but which, it seemed, proceeded from one of his finger-joints. I had given my opinion that the bone was united, and the gentleman was, at my request, permitted to use his arm, the powers of which returned to him rapidly.

I mention these circumstances to show the propriety of making up our minds as to the nature of the crepitus of fracture, by examining for ourselves such cases as may occur. In this way we acquire the tactus eruditus, without which we cannot determine upon the nature of some cases.

Sometimes difficult to discover crepitus.

In some fractures the broken bone is so surrounded with thick fleshy parts, that it is very difficult to feel crepitus, or, for a time, to ascertain the nature of the injury. Some fractures of the neck of the thigh-bone, unattended with retraction of the limb, are illustrative of this observation.

Other symptoms.

Other symptoms are mentioned, as diagnostic of fractures; such as loss of power in the limb, pain, swelling, and redness. All these are good collateral symptoms, but not one of them is pathognomonic. Loss of power in the limb may arise from a dislocation; pain may exist from a bruise, and so may swelling and redness. Deformity is another symptom enumerated, but this can seldom take place to any considerable extent, unless the soft parts are much torn; and, when it does exist, it may be a symptom of dislocation or fracture. Preternatural motion in the part is another symptom, but this may exist without being easily detected. When it is evident, however, in a bone, and is found to be the result of violence, it is of itself pathognomonic of a fracture. Hence we perceive that no one symptom is at all times present. How then are we to determine upon the existence of a fracture? I think thus: we may be sure that no fracture can extend through the bone without a diminution of power in the limb, or without our being able to produce that kind of crepitus occasioned by rubbing two uneven surfaces of bone upon each other, or preternatural motion in the bone; or an appearance of deformity in the limb. Then, in the absence of the signs of other accidents, our business is to inquire whether any one or more of the above four signs is present; and if we can find out one, we can usually discover others which will prove corroborative evidence. If neither of them does exist, we have no right to treat our patient for a fracture. If circumstances should arise to make the symptoms doubtful, we must make use of precautionary measures, till we can satisfy ourselves. Doubtful cases, however, rarely occur; but, as they are sometimes met with, it is necessary that we should be able to take a comprehensive view of them, in order to discover their real nature, for the welfare of the patient, and also to preserve our own reputation. To do this we must be acquainted with the different species and varieties of fracture, which we will now consider.

Different species of fracture.

This is a subject that requires our serious attention. It is not sufficient to know that a fracture exists; we must have an accurate knowledge of the circumstances of that fracture. Hence the definitions and distinctions of fracture is a matter of the very highest importance. For want of a knowledge of these many false notions prevail, and evils of great magnitude have crept into practice. The very name of each species of fracture should convey to the student some decisive line of treatment. Good arrangements in our science are like artificial common sense, by which those who have not natural ability to decide upon any individual case, are, in a measure taught their duty by its place in the system. Arrangement is therefore a necessary preliminary to general rules, and I shall endeavour to so arrange my definitions, that each subdivision of the subject may contain distinct and marked cases.

I shall attempt to explain the simple principles in this department of surgery, and if I should succeed in doing so to the understanding of my readers, they will be prepared to exercise their own judgment upon rational indications in the management of any particular fracture.

I shall begin by giving my views of the different varieties of fracture, and I wish to draw the attention particularly to this subject, for without a knowledge of it, it will be impossible to comprehend many important points of practice.

Surgeons have usually divided fractures into transverse, oblique, and comminuted.

By the term transverse fracture, I understand a fracture which passes transversely through the shortest diameter of the bone (as is represented in *Fig*. 1, p. 11). By the term oblique fracture, is signified a fracture which passes through the bone in an oblique direction (*Fig*. 2). This variety may extend through the bone in a direction downward and inward (*Fig*. 2), downward and outward (*Fig*. 3), downward and backward (*Fig*. 4), or downward and forward

(*Fig*. 5). When a fracture is comminuted, the bone is broken into three or more parts at the seat of fracture (*Fig*. 6). This variety may exist with other varieties of fracture at a distance in the same bone.

Considered according to the injury sustained

Fractures should not only be considered according to the degree of injury done to the bone, but also with respect to the degree of injury sustained by the soft parts. I shall view these accidents, therefore, in this way, viz: 1st. As consisting of fractures of the bone merely; and 2dly, of fractures attended with much laceration of the surrounding textures.

Fractures without laceration.

Incomplete.

Among the injuries which are confined to fractures of the bone merely, I believe that one variety consists in a partial division or crack of the bone, which for the sake of perspicuity may be termed an incomplete fracture. I have been led to form this opinion partly from various experiments, which I have performed upon recent bones while covered by the softer textures. Upon examining these bones in a denuded state, I have found that a fracture may extend in a transverse or oblique direction through a greater or less number of the fibres of a bone without passing completely through it; and that, if a

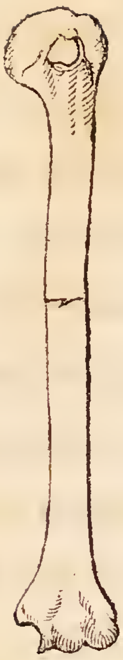

Fig. 1.

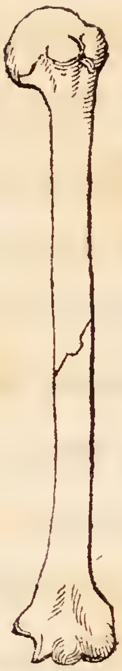

Fig. 2.

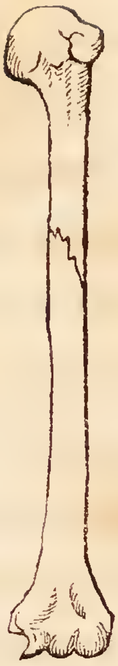

Fig. 3.

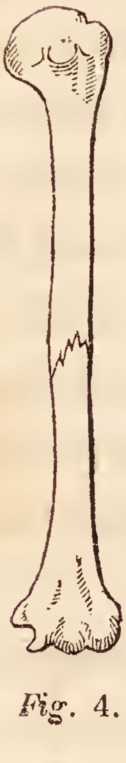

Fig. 4.

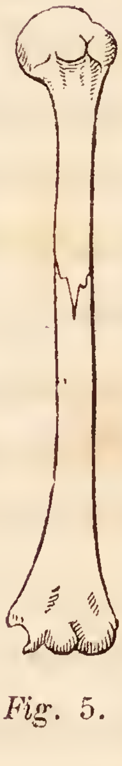

Fig. 5.

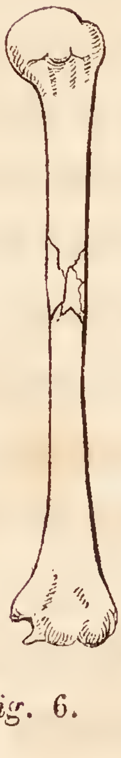

Fig. 6.

fracture of this description is attended with displacement, it consists in a bent state of the bone, with a portion of the edge of one or more of the fractured surfaces projecting at the salient angle, formed at the fractured part. One would be led to suspect the existence of such a fracture, where motion cannot be effected in the injured part in more than one direction; when this motion cannot be perceived in any other way than by attempts to bend the bone; from the simultaneous movement of the upper and lower portions, when the lower part is rolled; from the degree of power which the patient experiences in the limb; and from the rapidity with which a perfect consolidation of the fracture may be accomplished. I have not yet had an opportunity of examining the limb of any patient who may have died with the existence of such symptoms as I have mentioned; but, even in the absence of this proof, I think the facility with which this kind of fracture may be produced in recently dead bones, is sufficient to warrant the conclusion, that such fractures do occasionally occur in the living.

A force which may produce this fracture.

I can readily suppose the application of a force which would be likely to produce a fracture of this description. A person, for instance, while standing in the erect position, may receive a severe blow upon the back of the leg, but the force acting upon the limb may be only sufficiently powerful to break through a portion of the diameter of the bone, which would give way first at its anterior part. The same kind of fracture may be sometimes occasioned by the passage of a heavy body over the limb, as it lies upon the ground. If the fracture should extend nearly through the tibia, it would become evident to the surgeon in attempting to bend the bone, though he would not be able to produce any rotatory motion in the seat of injury.

Complete fracture.

A second variety of fracture consists in a complete division of the bone, unaccompanied by any considerable internal laceration of the soft parts. This variety, which I believe is very common, may be called a complete fracture, without laceration of the surrounding textures. A slight laceration will probably be produced in every case, but I wish it to be noticed that the laceration in this variety of fracture is trivial, sufficient to allow only of slight displacement. If the fracture be oblique, the broken ends may overlap a little. It may be here observed, that oblique fractures of this description ride very little immediately subsequent to the accident, but after the expiration of a few days they sometimes ride considerably. The increased displacement here alluded to, I presume takes place as soon as the projecting portions of the fractured ends have made their way through the opposing periosteum and other textures, against which they are forced by the constant action of the muscles.

Usually easily discovered.

Complete fractures, unattended with laceration of the surrounding parts, are very generally easily discovered. The fractured surfaces, however, occasionally become so locked together, that, in consequence of the simultaneous movements of the upper and lower portions, a nice examination is required, in order to discover the exact nature of the injury.

Comminuted.

Again, a bone may be *comminuted* without much laceration of the periosteum. Should the comminution extend entirely through the bone, the fracture may allow of being as readily displaced, as in cases without comminution, when the surrounding parts are much torn, and may require as much attention during the period necessary for its cure.

Fractures with laceration.

Besides the above varieties, which are not attended with any considerable injury of the surrounding parts contiguous to the bone, there are other fractures in which the contiguous textures are much torn. The laceration which accompanies this variety is *produced by the forcible separation of the fractured ends of the bone.* This laceration may take place at the moment of the injury, by a continuation of the force longer than is necessary to break the bone ; or it may be produced after the accident, by the incautious movements of the patient.

I do not mean to include under the head of laceration, the contusion of the muscles, &c., and the external laceration arising from the blow or other force that may have occasioned the fracture, for this is common to fractures and other injuries ; but I wish to confine it to the injury *done* to the *periosteum* and other *textures*, in *consequence* of the displacement of the broken portions of the bone. I would call such fractures loose fractures, or fractures with internal laceration of the surrounding parts.

Very evident.

These fractures are usually so exceedingly evident, that but little examination is necessary to inform the surgeon of the nature of the injury. They produce much pain to the patient, and require a greater share of the surgeon's attention during the cure.

Compound fracture.

When a fracture is accompanied with a wound leading to the bone at the fractured part, it is called a compound fracture. Now, I consider compound fractures as belonging to the species last described, as the difference in these cases consists only in the *degree* of laceration of the soft parts. The injury which the bone suffers in compound fractures, does not differ from the injury which is observed in simple fractures. The wound, however, which forms a communication between the bone at the seat of injury and the external air, places compound fractures under circumstances in some respects differing from those which are observed in other loose fractures; and, as the treatment requires to be regulated in some measure according to the varying circumstances as they occur, I shall hereafter venture to speak of compound fractures as a distinct variety of that species which I call fractures with laceration of the surrounding parts; and I hope I shall be able to show that these formidable injuries are now robbed of many of their terrors.

Fractures into joints.

Either of the above varieties of fractures may extend into a joint; this circumstance somewhat modifies the injury. Such fractures are often attended with high inflammation of the joint—and frequently, unless well attended to, soft anchylosis is the consequence.

Under one or the other of the above varieties, every fracture to which the long bones are subject may be arranged. I might have introduced further subdivisions, but my doing so I fear would not in any way tend to elucidate the subject.

Displacement.

In our attendance upon patients with fractures, we find, when we are first called, that the bones in some cases lie smooth and even, and in others the fragments are much displaced, producing an appearance of great deformity in the injured limb. This depends in a great measure upon the differences in the states of the accident, which I have already mentioned, and upon the formation of the injured part. If the ulna or radius, for instance, is fractured alone, but very little displacement commonly takes place, except in the transverse direction, because the bone which remains entire will resist the action of the muscles. The same may be said of fractures of the leg when one bone only is broken, and this is the case whether the fracture be transverse or oblique. But when both bones of the fore-arm or of the leg are broken, the displacement may occur in any direction almost as readily as in the femur, humerus, or clavicle.

The displacement which occurs in different states of fracture has not been sufficiently attended to, and to this and the vague notions which are entertained of fractures generally, we may attribute the seeming discrepancy which is observed in the opinions of different surgeons, when consulted respecting the importance of these injuries.

Now were gentlemen alike sensible of the differences in the accidents they meet with, even in the same bones and in the same situations, they could not come to such opposite conclusions as we sometimes have occasion to notice. One probably has only met with cases of the simplest kind, unattended with displacement, while another has been so unfortunate as to be called to cases occurring in the same bones in which the surrounding parts were much torn ; where the fracture, under such circumstances, might be difficult to manage satisfactorily by any of the common means, as in the clavicle for instance.

Thus, then, we see that the subject of displacement is one of very great importance; let us now, therefore, turn our attention to its particular investigation.

Causes of displacement.

The causes of displacement are either inherent in the limb, or are foreign to it, and purely accidental. It must be remembered that the bones are entirely passive, so that once placed right, they would of themselves ever remain so; and at the same time it must not be forgotten that the bones are only the frame-work of the body, and that they are constantly acted upon by the muscles, which must be regarded as the only powers inherent in the limb capable of displacing the fragments of a fracture.

Action of the muscles.

Those who are conversant with the nature of fractures are aware that the muscles are not voluntarily exerted as long as pain is produced in the injured part in consequence of their action, but they contract, independently of the will of the patient, by virtue of what is called their tonic power. The action of this power, though slight while the fragments remain in proper apposition, is increased by any thing that irritates the muscles; and it matters little in this respect, whether the irritation is produced by mechanical or other stimuli. In fractures, the stimulus to increased contraction is principally mechanical, and is the result of the displacement of the fragments of the fracture. One hour we may see a patient lying calmly with the fractured ends in proper apposition, without any particular pain in the seat of injury; and the next we may find him labouring under considerable pain in the fractured part, and great distortion of the limb. These effects he may tell you, perhaps, came on simultaneously, in consequence of some slight motion of the body, or spasm in the limb.

Accidental causes.

The accidental causes of displacement may be the gravitation of the limb, which may occasion the bones to fall into an unnatural position. The gravity of the body may have the same effect. Any accidental shake given to the bed or to the limb, or any motion given to the limb in the act of using the bed-pan, or moving the body in order to obtain relief from any uncomfortable position, may also produce distortion. Any one or more of these causes, I say, may produce displacement of the fragments of a fracture, and all its attendant evils, when the broken bones are not properly supported.

Direction of displacement.

The direction of the displacement of a fracture greatly depends upon the direction which the fracture takes through the bone. If the fracture be of that description which I have called complete fracture without laceration, displacement may take place in an angular direction (*Fig*. 7, p. 22) ; but as long as the periosteum continues but little injured, the fracture cannot be much displaced in the longitudinal or in the transverse direction. If the fracture be transverse, the displacement must be very great in the transverse direction, before it can take place at all in the longitudinal (*Fig*. 8). It may be angular and transverse at the same time (*Fig*. 9). It may be displaced at the same time in the transverse, longitudinal, and angular direction (*Fig*. 10).

Oblique fractures are more easily displaced than those which are transverse. In these fractures a slight displacement of the fractured ends in the lateral direction allows of displacement in the longitudinal; and this will be found to be proportionate to the degree of obliquity of the fracture. As long as the periosteum re-

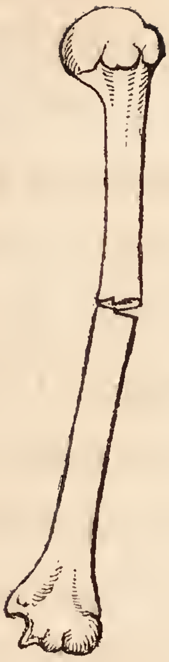

Fig. 7.

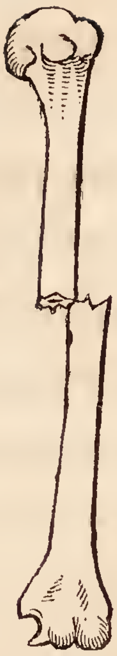

Fig. 8.

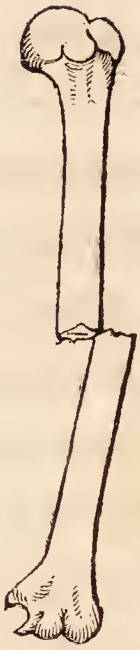

Fig. 9.

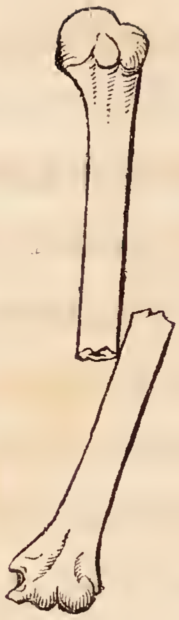

Fig. 10.

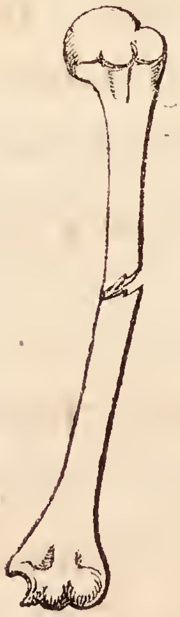

Fig. 11.

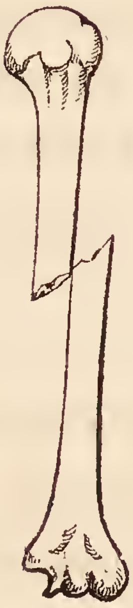

Fig. 12.

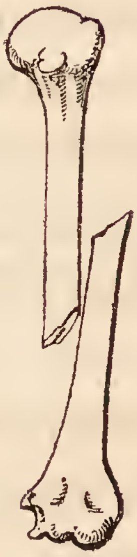

Fig. 13.

mains entire no displacement of consequence can take place, even in this variety of fracture, except in the angular direction (*Fig.* 11); but when there is much laceration of the surrounding parts, displacement occurs with much more facility than when the fracture is transverse. The cause of this is evident; when the fracture is transverse the fractured ends butt together and riding is prevented; but when the fracture is oblique, they are readily made to overlap. The displacement may be in these, as in transverse fractures, lateral and longitudinal (*Fig.* 12), or lateral, longitudinal, and angular (*Fig.* 13); but an oblique fracture cannot, like a transverse, be displaced laterally, without being displaced at the same time in the longitudinal direction, supposing no mechanical force is employed against the action of the muscles.

The name fracture not sufficient to convey the nature of the injury.

From what I have said, it will be seen that, in order to convey to the mind a correct idea of that injury which we call fracture, we must employ a complex term, or give a short description of its nature; for the word fracture only signifies, in surgical language, that a bone is broken; but this is not all that we ought to understand. If I am called to a case of fracture of the thigh, and I say, for instance, this is a very bad fracture of the thigh, the bones ride very much; no matter what part of the thigh it is in, I convey but a very imperfect notion of the injury. Again, suppose the fracture to be compound, and I say this is a compound fracture of the thigh, the bones protrude before or behind as the case may be, I by no means give a correct idea of its nature. The surgeon could not, from this description, form a distinct notion of the line of treatment, in a mechanical point of view, that ought to be pursued; it is a description, therefore, which is inadequate for the purpose for which it was intended, and consequently must be improper. In order to make this matter clear, it is better to connect the degree of injury to the bone and the line of division together, and add, when necessary, the internal condition of the soft parts. Thus, if I were called to a case of fracture of the thigh, and were to find the bone broken obliquely downward and inward, and riding much, I should say this is a loose oblique fracture of the thigh extending downward and inward; or, in other words, this is a fracture of the thigh extending obliquely downward and inward, and attended with considerable laceration of the surrounding parts. If I should find the bone protruding through the skin, the fracture would be compound, and I should then say—this is a compound fracture of the thigh, extending obliquely downward and inward. Every body would know what I mean by the former sentence, and in the latter there appears to me to be no ambiguity; for every compound fracture is attended with laceration of the surrounding parts, therefore the word laceration need not be employed. The nature of the injury may be thus defined, and the line of treatment to be followed more distinctly pointed out.

I wish the reader to bear in mind the different directions in which a fracture may occur, and the different kinds of displacement that have been mentioned, for he will find them of vast importance in conducting these injuries to a favourable issue—I mean an issue that does honour to the profession, and gratifies the patient and his friends.

Prognosis.

The prognosis of fractures varies according to the bone injured, the part broken, the direction of the breach of continuity, and the degree of mischief which may complicate the case.

In imcomplete fractures.

An incomplete fracture would require but little surgical assistance during its cure. It is the most simple kind of fracture.

In complete fractures.

Complete fractures which are not attended with internal laceration of the surrounding parts, are less dangerous than those which are attended with laceration.

In bones with large muscles attached to them.

Fractures which occur in bones that have many strong muscles inserted into them, are more difficult to manage than those in bones which have but few.

In oblique.

Oblique fractures require more attention than transverse ones; because an oblique surface does not resist the retraction of the lower portion of the broken bone, and some nicety is sometimes required in order to keep the fractured surfaces closely applied to each other.

In compound fractures.

Fractures complicated with a violent contusion of the soft parts, or with a wound rendering them compound, are much more dangerous than those which are free from such accidents.

Fractures in the leg.

Fractures of the leg are generally more serious than those of the upper extremity.

Into joints.

Fractures extending into joints are often more troublesome than those which occur in the middle of a bone.

A fracture may be rendered very dangerous by being attended with a wound of a large artery. Such cases, if compound, often demand immediate amputation. If a surgeon be required to see a patient with a wound of the posterior tibial artery, for instance, he will find the safest practice is to amputate, though, under favourable circumstances, now and then a patient may recover without amputation.

With a wound of a large artery.

In a debilitated old person, a fracture is less likely to do well than in a child or a strong young person. Old people sometimes die even from the effects of simple fractures.

Fractures in old persons.

CHAP. II.

THE EFFECTS OF FRACTURE UPON THE SURROUNDING PARTS—STRUCTURE OF BONE—CALLUS—EXPERIMENTS AND OBSERVATIONS—COMPOSITION OF CALLUS—EFFECTS OF INJURY UPON CALLUS—TREATMENT OF THE LIMB AFTER CONSOLIDATION IS COMPLETED.

WE shall now turn our attention to the investigation of the effects of those causes which produce fracture. This leads us, in the first place, to the consideration of the injury which may be sustained in the soft parts contiguous to the fracture.

Soft parts suffer first in some cases.

I have said that a fracture may be occasioned either by external violence or the contraction of the muscles of the limb. When a fracture is the result of external violence, the soft parts are usually the first that suffer. Sometimes, however, the force which occasions the fracture is applied so remotely from the injured part, that the bone in the situation of fracture is the first that feels the effects of injury. This we find to be the case frequently in fractures of the neck of the thigh-bone. It may, however, occur in other parts of the femur, as when the fracture is occasioned by a fall on the knee. This is the case, also, when the fracture arises from a violent contraction of the muscles.

In others the bone.

Effects of fracture upon the soft parts.

When the force first produces its influence upon the soft parts at the seat of fracture or even at a distance from it, it is followed by pain in the part at the time of the injury, as an almost necessary consequence of the contusion and laceration of the nerves which enter their substance. Those vessels which are torn through at the time the nerves are injured, pour out their blood into the surrounding cellular structure; and those vessels which are weakened by contusion, being no longer able to propel the blood forward as fast as it is forced into them by the *vis à tergo,* become distended; and from these two causes more or less tumefaction is speedily occasioned.

Tumefaction.

Pain.

The pain which accompanies increasing tumefaction may be referred, not only to the immediate injury done to the nerves, but also, even in the most simple kinds of fracture, to the stretching effect produced upon the nerves which enter into the coats of the dilating vessels, and to the stretching of those nerves which enter into the cellular and other soft parts, which became distended by the infiltration of the extravasated blood. The blood which is thus poured out from the open mouths of torn capillaries, is sometimes very considerable, occasionally amounting to several ounces collected in a part, undivided by the intervention of any structure. Another source of pain is the displacement of the fractured extremities and their occasional motion amongst the contiguous textures. The effects of the broken extremities in producing pain, when displaced and made to move amongst the parts, in a state of inflammation, may be imagined by conceiving the effect which would be created by the teeth of a saw if made to lacerate a whitlow.

Redness.

Redness is another effect which often comes on soon after the accident. This you are aware arises principally from the presence of the red particles of the blood in those vessels, which, in their natural state, do not admit them, but in their dilated state allow them to enter readily.

In this way we may account for the occurrence of the tumefaction which takes place so speedily after the injury; for the pain, which is more or less throbbing according to the sensibility of the injured part; and for the redness, which is more or less apparent according to the degree of dilatation of the vessels of the skin. These symptoms, viz: tumour, pain, redness, accompanied with increased heat, when collectively taken, are diagnostic of active inflammation of the part in which they occur.

Effects of inflammation.

You are sensible that active inflammation is always accompanied with more or less effusion of the component parts of the blood. Those capillaries which, in their natural state, are so small that they allow an animal vapour only to pass from them, when slightly distended, allow of the passage of serum, and when still more distended of fibrin. The effusion of these two component parts of the blood increase in proportion to the degree of active inflammation, and their presence, in an extravasated state, keep up the tumefaction in the part for sometime after the active inflammation has subsided, and many of the contused and lacerated vessels have resumed their natural tone and functions. This effusion might, therefore, go on so far as to retard the patient's recovery; and hence it is our

Tumefaction kept up after the inflammation has subsided.

business, even on this consideration, to moderate and keep under the inflammation which comes on in the fractured part immediately subsequent to the injury.

Effusion always occurs.

Effusion, in some degree, will always take place from the inflamed vessels, if the powers of the patient are strong enough to produce re-action, and should be regarded as a part of the restorative process of Nature, which we may moderate when necessary, but by no means altogether prevent. In order to render the effusion moderate—for no more should be attempted—it will be expedient to prevent or remove all those causes which tend to irritate the soft parts contiguous to the fracture; and to employ such means as tend to subdue existing inflammation, supposing that it runs too high.

Means to moderate effusion.

With a view to answer the first indication, it will be adviseable to reduce the bones as early as possible, and fix them in their natural situation. The inflammation which comes on, as a consequence of the fracture, may be moderated or subdued by general and local antiphlogistic treatment. Bleeding, in some few cases, may be required as a constitutional remedy. An occasional dose of aperient medicines will be found highly advantageous in most cases, and will often supersede the use of the lancet, even in those cases where bleeding is apparently necessary. Leeches to the injured part, when there is much contusion, are highly beneficial. Cold sedative lotions, applied so as to allow of free evaporation, contribute greatly to reduce the inflammatory action. Generally the best lotion of this description is goulard-water, with a small quantity of spirit. We must take care, however, not to reduce the action in the part too much—always bearing in mind that an action higher than is natural to the part, facilitates the formation of callus.

Time of setting a fracture.

I cannot quit this part of my subject without making two or three remarks upon the proper period of what is called setting a fracture. This, in common language, signifies nothing more than placing the bones right, and keeping them in that situation. This part of the treatment is performed at different periods by different surgeons. Some suffer a limb to lie on a pillow for many days, allowing the broken ends of the bone to pass each other, if the fracture is oblique, without making any attempt to prevent it, under the idea that any opposition made to the contraction of the muscles only acts as a stimulus to more powerful contraction: as an old hospital surgeon once observed to me, "The more you extend the limb the greater will be the deformity arising from contraction." I had an opportunity more than once of showing this gentleman the fallacy of his argument, and I believe convinced him, though apparently much against his will. These gentlemen seem to dread the effects which might be produced by placing any thing upon the limb, with a view to keep the fractured extremities in their proper situation, while there is any active inflammation in the part. They fancy that mechanical means augment the action of the muscles, and increase the inflammation. These two arguments are the principal advanced in favour of the practice which they pursue. They are, indeed, arguments which, in a great measure, apply to the means commonly resorted to; but I believe I shall hereafter be able to show that these means are inadequate, and that this practice is decidedly improper.

Muscles acquire a fixed contraction.

The impropriety of this plan will be apparent, when it is considered that the muscles, if allowed to contract in a state of inflammation, acquire a fixed contraction, which, in a few days after the accident, becomes so firm as to afford great resistance to the process of reduction;

this, it might be said, is of no consequence in the opinion of those surgeons, who allow the bones to ride as much as they will—say three or four inches, and then suffer them to unite in that situation. But even in this view of the subject, which is by no means pleasant to contemplate, when we consider the effects which the broken extremities of the bone, pricking and lacerating the soft parts, with which they come in contact, must have in keeping up and increasing active inflammation, the consequences of which, as far as is necessary for our present purpose, I have already detailed, we see that to suffer the fractured limb to lie unprotected from the action of its own powers as well as from those which may be accidentally applied, and which have a tendency to disturb the natural position of the fractured ends, is a matter of no trifling importance to the patient. Nature, as I have said, sets up an action in the part immediately subsequent to the accident, which, if kept within due bounds, is salutary. The effusion which takes place under this action produces adhesion of all the parts surrounding the fracture, and tends to fix them. This consolidation, or more properly agglutination of the soft parts, in my opinion, must be regarded as one of the first

Adhesion of the soft parts.

steps of the reparative process. When this has taken place, say at the lapse of eight or ten days, can the fracture, if oblique and riding, or can it, if at all displaced, be reduced as easily as at first? Certainly not: when the fractured ends are much displaced, they cannot be brought into proper apposition at all, without tearing through the salutary adhesions. Surely then, the time when a fracture should be set is a matter which demands our serious consideration.

Effects of violence in reducing the fracture at this time.

If the limb is suffered to lie till the active inflammation has subsided before the displaced bones are properly reduced, the surgeon must frequently use great violence to bring the fractured ends into their natural situation; and this will sometimes be exerted without success. He must stretch the contracted muscles; he must tear through the ligamentous adhesions which Nature had made to fix the surrounding parts; and, consequently, must destroy the first step of the reparative process; oblige Nature to do over again, imperfectly indeed, what she had already properly accomplished; and, at the same time, give the patient great and unnecessary pain. So great is the pain sometimes produced at this period in the reduction of a fracture, that if it should afterwards get deranged, many patients would rather put up with any degree of deformity, than suffer again the torture which they had previously experienced.

Practice to be modified by circumstances.

I do not wish to be understood as recommending the surgeon to reduce the fractured ends immediately, and adjust them properly at once, in every condition of the neighbouring tissues which he may be called upon to witness, but simply if he be called to the case before active inflammation has commenced, he should reduce the fracture with as little delay as possible. If he should find the parts much inflamed, and tumefied, he should nevertheless commence immediately, and proceed to effect his purpose by degrees, in proportion as their condition will allow; which he will be able to accomplish without violence, under the influence of means hereafter to be described, in all cases where their application is admissible, as is always the case in the lower extremities during the continuance of the high active inflammation in the contiguous textures. The practice here recommended is of so much importance, that in my humble opinion it cannot be too strongly insisted on. But more of this hereafter.

Mottled appearance of the skin.

To return; a few days after the accident, under favourable circumstances, the limb frequently assumes a mottled appearance, particularly in persons of thin skin, and lax fibre. This in itself is hardly worthy of our notice; but, as patients are apt to feel alarmed when it occurs, I shall take this opportunity of mentioning its causes.

Causes.

The blood poured out from the lacerated vessels usually insinuates itself, while it remains in a fluid state, amongst the cellular substance for a considerable distance from the fracture. That portion of it which is extravasated in the cellular substance immediately beneath the cuticle, creeps along in every direction, over a large portion of the limb; principally gravitating towards the most dependant part. This blood soon acquires the characters of venous blood, becomes of a dark modena colour, and coagulates. While it is assuming this colour and consistence in some parts, in others, Nature is effecting its removal. Serum and fibrin is poured out and mixed with the clotted blood in different proportions, in different parts. Here we see that the blood exists in its solid form in one part, its red particles are partially absorbed in another, and in a third it is mixed with serum and fibrin; producing, at the same time, in different parts, a dark brown, a dark yellow, and a brightish yellow: and these different colours being gradually lost in one another, like the colours of the rainbow, give rise to the variegated appearance of which we are now speaking, and which is more particularly evident in persons whose cuticle is thin and delicate. Our knowledge of the causes of these appearances enable us to assure our patients that they do not of themselves indicate the occurrence of any untoward symptoms, but rather of returning vigour in the vessels of the limb.

Having made these few general remarks, on the effects of injury accompanied with fracture, we will proceed to a more particular investigation of those changes which take place in the reparative process. In order to give as complete an idea of this as the present state of our knowledge will allow, I shall first mention the growth and structure of the cylindrical bones, as far as they have been ascertained by observation and experiment. In doing this, I need not enter into a minute detail. My professional readers are aware that bone is composed of earthy and animal matter; that the long bones are lined with the medullary membrane, and covered with what is called periosteum. All that I wish to state upon this subject, is the mode of formation in the long bones; the arrangement of the fibres; and the different states in which they are found at different periods of growth; which I shall do upon the authority of Mr. Howship.

Formation of bone.—Bone first deposited.

At an early period of gestation, a hollow cylinder of bony matter, arranged in tubular plates, is laid down from the periosteum in the centre of the bone, antecedent to the formation of cartilage. Within this cylinder and at its ends, at the time that it is first formed, is placed a gelatinous matter.

Then cartilage.

At a certain stage of the process, the mode of operating is changed, in order that it may proceed more expeditiously. Cartilage is now formed in the gelatinous matter. This, by the nature of its organization, having a specific provision of cavities and canals, which are lined with vascular membrane, is well adapted to allow of the rapid growth of bone; while, at the same time, in the opinion of Mr. Howship, it serves to determine the future figure of the bone, by establishing and conducting the ossification within its own substance.

The ossific matter in the cylindrical bones is deposited, primarily, in the form of fine thin tubular plates. At the points where ossification is proceeding, the surface is arranged in tubular plates, with tubes of two different sizes, constituting a larger and a smaller series. This arrangement, however, is by no means essential to the increase of a bone, because in many of the earlier stages of ossification, and also where the growth is very slow, the larger series is found to be entirely wanting. The only apparent use of the larger series of tubes, is that of augmenting the quantity of blood circulating through the ossifying structure, so as to increase the rapidity of growth: for they are abundant in animals of quick growth; less numerous in those that reach maturity slowly; and, in the same animal, they are employed by Nature, or laid aside in conformity with quick or slow development of structure, which from experience, we know actually takes place at the period when the examination is made.

Bone deposited in tubular plates.

Tubes of two sizes.

Large tubes not necessary.

The ultimate texture of bone is not laminated, but reticulated; the phosphate of lime being deposited, as an interstitial substance, external to and around the smaller series of tubes; for although, from the greater compact-

Ultimate texture.

ness necessary to the bones of quadrupeds, the ultimate structure is not in them so readily demonstrated; yet in the more delicately constructed bones of birds, it is said to be sufficiently obvious, and may at any time be easily traced.

Tubes evident in young animals.

The plates of the cancelli consist of tubes of ossific matter which, in the young animal, are very evident, but as the animal gets older, the interstitial or bony matter increases in quantity, and the tubes become gradually smaller, and the bone more compact; till at last, at the adult age, these tubes are scarcely perceptible.

Inferences.

Here we see that young animals have a greater quantity of animal matter in their bones than old ones, consequently, their bones have a greater degree of elasticity, and are not so liable to be broken. We perceive too that the growth of a bone, is more or less rapid in proportion to the quantity of blood circulating through it; hence, we may infer, in conformity with what we observe in the growth of other structures, which have a vigorous circulation, that the reparative process will go on more or less rapidly according to the age and health of the animal. This we find to be actually the case. The bones of children unite much more rapidly than those of adults, and those of adults more speedily than the bones of old people.

Callus.

Callus, to which I have now to direct your attention, is a bony deposit formed, during the reparative process, for the purpose of consolidating the broken extremities of the bone.

Opinions of the older surgeons on callus.

It appears that the older surgeons believed callus to be a mere inorganic concrete, a fluid poured out from the extremities of the ruptured vessels which was soon hardened into bone; but it set or hardened, in their opinion, like stucco or plaster of Paris; and, if not discomposed during the process, hardened into the consistence of bone. They described it always as an exudation of the bony juice, which after a time becomes a concrete. They supposed it to be a peculiar juice circulating in the bones ready to be poured out, in order to re-unite them when fractured. They believed that it might be moulded by compression and bandage during the period of its formation.

Arabians attended to the form of the callus.

The Arabians attended in a particular manner to the form of the callus. Its exuberance was supposed to be a sure consequence of slack bandaging. The deformity, if any occurred, was attributed to this cause, and was considered a disgrace to the surgeon. They took upon themselves the whole management of the callus, and such was the firmness with which the Arabian surgeons applied their bandages, as they conceived, to mould the callus, that not only while the callus was growing did they draw their bandages within a very little of producing gangrene, but they continued them afterwards to prevent the prominence of the callus, till, by their tightness, the limb was much wasted. When a limb is much wasted by tight bandaging, it is a considerable time before it recovers itself; and the Arabians found it expedient to assist Nature to restore its natural plumpness. Hence they directed that plasters of pitch should be applied upon the limb to draw the juices that way. Pleasant tales and luxurious living were also prescribed as highly advantageous.

Particular days appointed for taking off the bandage.

Under the idea that callus is a juice, which infallibly concretes in a certain period of time, they appointed particular days for undoing the bandages, and examining the limb; and, if on those occasions, they found the callus exuberant, producing a deformed appearance, they endeavoured to soften it by friction and oil, conceiving that they should be able to render it flexible and correct its exuberance and knobby deformities by the assistance of compresses, pillows, and bandages: for want of a proper knowledge of natural and morbid phenomena, as they are observed in the animal body during life, their notions were purely mechanical.

Believed they could soften the bone by friction and oil.

But modern discoveries have enabled surgeons to form a more complete idea of the nature and formation of callus. We know that the bone is a well organized part of the body, possessing nerves, arteries, veins, and absorbents. We know that it is originally a secretion derived from the blood, and that it is deposited by arteries, or by a peculiar apparatus formed of arteries; and that callus is nothing more than a regeneration of bone, made and deposited by the arteries, or an apparatus formed of arteries, in the same way as that which forms the original bone.

Bone organized

It is of practical importance to make ourselves acquainted with the formation of callus; but in our attempts to do this we must discard all wild hypotheses. The knowledge of this process is not to be acquired by reasoning only;

Observation and experiment necessary to discover the formation of callus.

we must have in addition for this purpose, close observation and experiments. I shall, therefore, proceed to speak concisely of the various steps of the process, as far as I have in this way been able to discover them, from the experiments and observations made by myself and others.

Tumour round the fracture.

I have stated above the effects of simple fracture upon the soft parts; that it bruises and lacerates the vessels, and gives rise to effusion of blood; that these effects are followed by inflammation, which produces an effusion of serum and fibrin, which, with the effused blood and enlarged vessels, give rise to swelling over a considerable part of the limb, commonly accompanied with a particular tumour surrounding the fracture. This tumour soon becomes hardened and firm, and feels as if there were formed round the bone a gland-like-mass, for the purpose of generating callus.

Structure of the tumour.

When we cut into the leg of an animal a few days after the bones have been fractured, and examine this tumour, we find the muscles, the cellular substance, and the periosteum thickened and firmly adhering to each other, and presenting to the eye but little of the natural appearance or structure. This, which might be called the provisional tumour, and which, at a certain stage of the process of union, we usually observe surrounding a fracture, might be said to consist of the neighbouring soft parts which encircle the fractured ends, altered in appearance, effused blood, enlarged capilliaries, serum and fibrin. In this mass a vigorous circulation is carried on for the purpose of generating bone, the vascularity appearing to be the greatest in the thickened periosteum. After a time the high action subsides, and the swelling and thickening ultimately disappear.

But let us trace more particularly the process of union in simple fractures, from its commencement to its completion.

Quantity of blood effused varies according to circumstances.

Situation.

We have observed that the first effect of fracture is laceration of vessels, and consequent extravasation of blood into the surrounding soft parts. The quantity of blood poured out varies according to the degree of contusion or complication. Great part of this blood is diffused through the cellular tissue of the periosteum, increasing its thickness after the manner of ecchymosis in common cellular membrane. A similar effusion takes place from the vessels within the medullary cavity, and a coagulum is deposited in each of its openings. There is also more or less blood extravasated between the fractured parts of the bone. But, although the smaller coagula in the openings of the medullary cavity, and the larger quantity of blood between the ends of the bone were probably at first continuous, they are said to be readily distinguished in examinations which are made soon after the injury: the former being more tenacious and elastic, the latter retaining the properties of common coagula.

Difference in the coagula.

Blood soon coagulates, and the colouring matter disappears.

It may be observed that the blood soon coagulates, and subsequently most of the colouring matter disappears; and, it is probable, that the greater freedom of circulation which is observed, is the means of effecting these changes earlier and more completely in the blood deposited in the cellular tissue of the periosteum than elsewhere; although these circumstances do not materially influence the subsequent establishment of ossification.

Twelve hours.

As early as twelve hours after the injury, the periosteum is more or less loosened in the neighbourhood of the fractured ends, and is gorged with effused blood; an appearance which is also observed in the other neighbouring tissues.

Twenty-four hours.

Twenty-fours hours after the fracture the periosteum is found loosened to a considerable extent, is finely injected with blood, and apparently thicker than natural. The periosteum at this time lies in contact with the bone, but has very little vascular connexion with it. A serous fluid is sometimes found between the periosteum and the bone, and separating them from each other, to the extent of an inch or more from the fractured ends; the surface of the periosteum, which is separated from the bone, appearing smooth and shining. Where the periosteum is not torn by the separation of the fractured ends, or in other words, in complete fractures without laceration, it becomes detached from the surfaces of the bone in the same manner, though perhaps not to the same extent, as in loose fractures.

Forty-eight hours.

At the end of forty-eight hours after the injury, the differences observed in the condition of the soft parts from those which were noticed twenty-four hours after the bone was broken, were not great. The clots in the fractured ends adhered very firmly to the bone at this time, and did not yield to brushing with a camel's-hair pencil applied under water. The centre of the clots was of a dark red colour.

Third day.

On the third day Mr. Howship observes that the vessels visible in the contiguous parts are very numerous, scattered over the fine transparent laminæ which cover the coagula, and separate them from each other. This is especially the case near the seat of injury. The coagula have not as yet lost any of the red colour. The periosteum in the neighbourhood of the fracture is sometimes so completely changed with effused blood, that the altered state of the membrane and the close adhesion to the bone of that which was evidently coagulum only, rendered it at some points extremely difficult to say which was and which was not periosteum.

Fourth day.

On the fourth day a considerable degree of consolidation of the soft parts surrounding the fracture had taken place. At this time the periosteum is occasionally more adhering to the surface of the bone, though as yet the connexion amounts only to a few small thin transparent membranes, each about a line in width; the periosteum being still separated from the bone to a great extent by the presence of serum. The clot in the calibre of the fractured end was now partly organized; and, unless I am much deceived, the vessels running into its circumference were large enough to receive injection.

The centre of the clot appeared of a dark colour, while the circumference had the colour of vermilion.

Fifth day.

On the fifth day the provisional tumour when cut into had more of a semi-cartilaginous appearance. The periosteum had now become more adherent to the bone, but readily pealed off when gently raised with the forceps. There was but little moisture observed between the bone and periosteum at any part. A layer of soft parts was found closely adhering to the clot in one of the fractured ends. On examining the clots in the ends of the bone, one of them appeared to contain a great deal of vermilion; the dark colour common to the injected clot had now disappeared. The surface of the periosteum nearest to the bone, when pealed off, was shining and very vascular.

Sixth day.

On the sixth day the provisional tumour is composed of a dense mass; the periosteum and other soft parts have now become so blended together, as to render it very difficult to distinguish them from one another—ossification had now commenced. Parts of the mass appeared cartilaginous, having specks of bony matter interspersed, but especially on the surfaces of any small cavities that were observed. The new bone deposited on the surface of the old has the appearance of numerous lines of a rough white substance laid down at intervals, and readily distinguished from the surface of the original bone, which is smooth and of a brownish colour. Osseous matter is found secreted also at this time round the margin and within the medullary cavity of the bone: the fractured part has at this time acquired a good deal of firmness. Mr. Howship states that, in an experiment which he made, he found the vascularity of the membrane covering the coagula very great on the sixth day, and especially over the large coagula situated between the broken ends of the bone. At certain parts, the bright masses of injected vessels had the appearance of pure vermilion extravasated; but, on examining them with a microscope, the arteries, although innumerable, were found every where distinct. The small coagula, within the openings of the fractured ends of the bone, were surrounded, towards the inside, by an inconceivable number of vessels. Mr. H. observes, however, that he could not distinctly say that any of the injected arteries had passed into the coagula in this instance.

On the seventh day ossification had still further advanced. The periosteum adheres closely to the bone at this time for the most part, but there is sometimes a little serum discovered in different situations between the bone and the membrane. Seventh day.

On the eighth day there was but little difference observable, except a greater degree of advancement in the process of ossification. In one examination, made eight days after the injury, I found three fractures. A comminuted fracture at one part; an oblique fracture without comminution at another; and, between these two, an incomplete fracture passing through about two thirds of the diameter of the bone. The fractured surfaces in the oblique fracture were held together by the fibula, and were surrounded with callus firmly adhering to the bone. Eighth day.

On the ninth day there is more bony matter observed throughout the mass; about this time the periosteum has much of the appearance and character of cartilage, and Mr. Howship thinks it might be said to have assumed all the properties of true cartilage. In one examination which I made on this day, there was found a semi-cartilaginous substance between Ninth day.

the surfaces of the bone which came nearest together. Though this deposition allowed of considerable freedom of motion, in consequence of its elasticity, it held the surfaces strongly, and formed a bond of connexion between them ; having within its substance a considerable quantity of bony matter, which firmly adhered to one portion of bone, and was extending towards the other, so as to form a continuous bar of callus. There was, in this instance also, bony matter laid down so as to cover the circumference of both the fractured ends.

From the eighth to the tenth day might be observed a ring of new bone, shooting from the calibre of the old bone, in a situation corresponding to the circumference of the clot deposited in the fractured end—at this time the clot admits of being beautifully injected.

Eleventh day. On the eleventh day the process of ossification has still farther advanced. Bony matter may now, in some instances, be observed in the centre of the clot, as well as in the calibre of the old bone corresponding to its circumference. On making a longitudinal section, I cut into the cavity of the sac formed by the provisional tumour, which contained some bloody serum, and in which the fractured end of the upper portion of the bone moved freely. The surrounding textures had become dense, and were for the most part of a semi-cartilaginous structure; a considerable quantity of provisional callus existed between the two portions of bone, sufficient to separate them about half an inch from one another. The periosteum covering the upper piece, adhered very closely, and contained bone apparently to within about a quarter of an inch of the fractured end, which was filled up and rounded off by a dense bony mass covered by *a thin highly vascular membrane.* This thin membrane did not adhere to the sac in which the end of the bone moved at any part. The bony matter forming the plug, appeared to be the result of the ossific action in the clot itself. From the appearance of the callus in the fractured end, in this instance, I should infer, that the process of Nature in the progress of ossification, is to lay down a bony ring upon the wall of the calibre of the bone, and to form a centre of ossification in the clot. The work then advances from the old bone towards the centre of the clot, and from the centre of the clot towards the old bone, till the two portions of callus are brought into contact. They then, as appears from other experiments, coalesce, and form a firm bony mass, completely filling up the mouth of the calibre of the bone. I found imbedded in, and firmly united to the provisional tumour which had formed in this case, a splinter of the original bone nearly of the diameter of the tibia, and about three fourths of an inch in length.

Thirteenth day.

On the thirteenth day I found the periosteum had become adherent to within a line of the fractured end, and bony matter was deposited in it. In this experiment, I observed one of the fractured ends had worked its way through the integuments, and was surrounded with some cheesy matter for about a quarter of an inch within the skin. The periosteum, in this piece also, was full of bony matter, adhering so strongly to the surface of the old bone, as not to be easily detached by the knife. The fractured ends were separated from one another about a quarter of an inch. All those portions within the skin were surrounded by new bone; but the greatest quantity of bony matter was laid down between them, covering most extensively those surfaces which were most nearly approximated. The provisional tumour was made up of a semi-cartilaginous mass, containing bone, which was more abundant in those parts which formed the extremities of the tumour, where it approached nearest to the original bone.

Sixteenth day.

On the sixteenth day the provisional tumour was much less than appeared when the injured parts were examined at an earlier date. The muscles running over the fracture, were now easily separated from the tumour, and were beginning to assume their natural appearance. The fractured ends rode over each other, and were united by callus, containing a large quantity of bone. The mass was covered by a dense membrane, thicker than the original periosteum, and closely adhering to the callus. The fractured ends had become filled with callus of a much firmer texture than that which was observed at any other part. That portion which was formed in the centre of the clot, and that which was laid down upon the calibre of the original bone, had now coalesced and formed a continuous mass, in which there was no apparent line of separation.

Eighteenth day.

On the eighteenth day the muscles moved freely upon the hard mass surrounding the fractured ends, and had nearly acquired their natural appearance. The membrane covering the callus was perhaps thinner than it was found to be on the sixteenth day. The fractured ends were united with a great degree of firmness. They overlapped considerably, and the grooves formed by bringing the two cylinders together were filled up with much gibbosity. But little bony matter was deposited on the surfaces the furthest separated from each other. The fractured ends were rounded principally by the new deposite, and covered up, so that the irregular surface of the fractured edges no longer appeared. Upon making a section in a longitudinal direction, it was found that the same general law which was observed in the former experiments, also regulated the union in this instance; the bony matter having been deposited in a direction principally from the circumference towards the centre of the mass: the centre being that which commonly requires the longest period to become firm and compact, or in other words, the last part in which the process of consolidation is completed. Between the surfaces of the original bone, which lay nearest together, the soft matter was highly vascular, and contained small coagula.

Twentieth day. On the twentieth day ossification was still further advanced. The parts had acquired a greater degree of firmness, but were not yet sufficiently united to prevent the fractured ends from moving, when firmly handled for the purpose of ascertaining the degree of solidity which had taken place. Upon dividing the callus there was discovered, running through a considerable part of the centre of the mass, an irregular line of soft matter, which contained very little bone, and which allowed of the movement that I was still able to produce.

Twenty-fourth day.

On the twenty-fourth day the state of the soft parts had become nearly natural, and the provisional tumour had disappeared. The periosteum adhered firmly to the original bone, and was but little thicker over the callus than at any other part. The bone was divided in the longitudinal direction into three parts. The fractured ends were secured in their new situation by callus, which had become for the most part bony, filling up the crevices and irregularities, so as to convert the whole into a solid structure. The callus was still cellular and very vascular about the centre, and in some places appeared to contain but little bone. The process of Nature after this period is to increase the density of the callus, and remove all that is superfluous.

Ages of rabbits.

My experiments were performed on the legs and thigh-bones of rabbits from three to eight months old. The difference in the age of the rabbits, and the circumstances of the fracture, will make some difference in the results; and will, in some measure, account for the want of perfect uniformity, which will be observed in comparing the details related by those who have made the union of fractures a subject of experimental investigation.*

Softening of the bone.

Mr. Hunter says, that one of the first steps in the formation of callus is a softening of the original bone; but Mr. Howship thinks that Mr. Hunter must have meant that interstitial absorption takes place in the old bone, which renders it weaker than before, as he has not, in his experiments, been able to discover any of the appearances of inflammation in the substance of the bone at the seat of fracture.

Callus formed in gelatin.

Some surgeons believe that callus is formed in gelatin. They state that a nidus of gelatin is formed, and, in this, cartilage is deposited.

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* I understand that M. Dupuytren has experimented largely upon this subject, and that he has arrived at results very similar to those which I have detailed. I have not yet seen his observations.

When the cartilage is formed, they say that bone is laid down in it in specks, in the same manner as in the epiphyses of young bones.

Inferences.

My experiments and observations, in connexion with those of Mr. Howship, have led me to draw a different conclusion.

From all that I have been able to discover, I am led to believe that the blood effused after fracture suffers various degrees of change, regulated by its situation; but, under all circumstances, when the fracture is simple, I should state, with Mr. Hunter and Mr. Howship, that some of it becomes organized, and that bone is deposited in many of the coagula which exist in and about the fractured ends. My observations, however, have led me to go further, and say, that osseous matter is not only laid down in some of the coagula and upon the surfaces of the original bone, but that bone is also abundantly deposited in the provisional tumour. I have not noticed this in any considerable quantity earlier than the sixth day after the injury.

I find that Nature, in the union of fracture, sets out upon a large scale, varying however, the extent of her operations according to the circumstances and conditions of the injured parts. She lays down bony matter upon the surfaces of the original bones, and more or less throughout the dense part of the provisional tumour. In the tumour, where ossification for some time goes on more rapidly than at any other part, the bony matter is first observed in specks variously deposited, which gradually coalesce and form large masses. These specks are first observed near the circumference of the tumour, especially at those parts where the circumference approaches nearest to the original bone. The tumour commonly envelops all those portions of the bone from which the periosteum has become detached; and in it is formed, before the process of ossification ensues, a small cavity, the walls of which are lined by the detached periosteum; and in this cavity the fractured ends of the bone are situated, and are found for a time surrounded with a mixture of coagulated blood, serum, &c. The periosteum, which is situated immediately above and below the cavity, continues to adhere to the bone, and forms the bond of connexion between the other tissues of which the provisional tumour is composed, and the external surface of the bone. At these parts, which might be called the ends of the tumour, the secretion of bony matter goes on very actively in the rabbit after the sixth day. Here, in some instances, the new bone is laid down in such abundance, as to appear like a regular growth proceeding from the surfaces of the old. The work advances over the tumour near its circumference, and soon forms an external case more or less regular, within which the future steps of ossification are completed. Within this case is now formed small masses of bone in various parts of the substance of the tumour, upon the surfaces of the old bone from which the periosteum is detached, and in the coagula which fill up the orifices of the fractured ends; the quantity, however, and mode of arrangement differing very much in different instances. The ossific process goes on now nearly from the circumference towards the centre, where the bone is at last deposited in sufficient quantity to make up the solid structure. When the mass has acquired a certain degree of solidity, Nature begins to absorb the fibrin and gelatin, and also the bony matter deposited in and among the muscles and other textures, of which the provisional tumour is composed; and thus the muscles and other original tissues involved in the tumour are again gradually set at liberty. When this is accomplished, which often happens before the union is completed, the callus is found covered by a dense membrane, varying in thickness at different periods after the injury. The ossific process is now concentrated principally to the surfaces of the old bone, which approach nearest to each other, and to those surfaces which are nearest to them; gradually advancing, commonly, from the latter towards the former. In proportion as the new structure becomes dense and unyielding in the more central parts, absorption appears to go on irregularly at its external surface, so as gradually to reduce the bulk of the callus to such dimensions as the peculiar circumstances of the fracture may ultimately require; Nature always taking care to leave a sufficient quantity of the new bone to support the fractured ends with that degree of firmness, necessary for the performance of all the usual functions of the limb.

In transverse fractures.

It is found that the circumstances of the fracture, evidently influence and regulate the quantity and seat of the ossific deposite. In simple transverse fracture with little contusion, where the bone is immediately reduced and the limb kept perfectly quiet, the degree of internal laceration is small, the effusion of blood inconsiderable, and the ultimate deposit of bone moderate in proportion. Ossification is in this case established within each orifice of the broken bone, and also round the external margin, extending itself to some distance above and below the seat of fracture.

Oblique.

In oblique fractures, where the bones have suffered more violence at the moment of the accident and are reduced with more difficulty, the effusion of blood will be greater, and the quantity of ossific matter formed will, in many cases, be also more abundant; especially if the bones are suffered to overlap. The appearances, in such cases, are materially different from those observed in transverse fractures, unaccompanied with any considerable injury to the soft parts. In the transverse fracture, the ossific matter is deposited equally, presenting usually a gentle elevation, extending above and below the line of the division. In the oblique fracture the appearances are less uniform. If any motion is allowed, points of irritation are established dependent on the circumstances of the accident; but, in the oblique as well as in the transverse fracture, a free secretion of ossific matter commonly takes place within the medullary cavity. This you will perceive upon examining an oblique fracture of the thigh where union has just taken place. If the ends of the bone overlap, so as to bring the sides of the cylinder into contact, the principal ossific deposit is soon concentrated between and near the contiguous surfaces, while but little deposit will be left in the mouths of the fractured ends, or covering the sides of the cylinder which are not opposed to each other. This will be found illustrated in thigh-bones which have united in the manner I have mentioned.

Comminuted.

When the fracture is not only oblique, but attended with extensive contusion or comminution, there is a broader foundation for repair. It will be observed that Nature, in these cases, seeks to compensate for the unfavourable state of the parts, by increasing the extent of the sphere of her operations as far as may be necessary for the union of the fragments with the principal portions of the cylinder into a single bone again.

Union of detached splinters

As the union of splinters entirely detached may be doubted by some surgeons, I may here remark that Mr. Hunter was of opinion that when portions of bone are torn off from the cylinder and are entirely denuded of their periosteum, it often happens that they accept of union in the same manner as a transplanted tooth, unless their vitality is entirely destroyed. This process of union I have observed in progress, (See Ex. on eleventh day, p. 54) and Mr. Howship has a preparation in which is seen a splinter of bone imbedded in the *middle* of a *callus*, and firmly united with it.

When the callus is firmly consolidated with the bones in tolerable apposition, the limb is, for a considerable time, stronger in that part which had been fractured than any other, which arises in consequence of the bone being, in that part, of a solid instead of a hollow cylinder.

Composition of callus.

As for the composition of callus, from its constant disposition to crack and split off under calcination, when it is external to the original bone, and from the uniform but great contraction it exhibits on being exposed to heat, where the newly-formed bone is at liberty to contract, it appears that the new deposition contains a larger proportion of animal matter than the original bone; and it is worthy of remark, that this character is very distinctly observed in callus, examined several years subsequent to the date of its production.

Vascularity.

New callus is more vascular than the original bone, and it is probable that it continues to be so several years after it is deposited. Mr. J. Bell injected the leg of a man which was fractured twelve years before, and he states that, while the bone itself received the red colour of the injection pretty freely, the callus was very singularly red. From this we may infer that the callus is sometimes more vascular than the original bone, even at the distance of twelve years from the period of its formation. Nature then, it seems, has two standards for the composition of bone; one for the original, and the other for the callus.

It results from the doctrine which I have endeavoured to point out, that bone is deposited in the provisional tumour, in the periosteum and medullary membrane, in some of the coagula, and on the surfaces of the original bone; that the newly-formed callus contains more animal matter, and is more vascular than the original bone for a considerable period after it is consolidated.

Callus at first soft.

For some time the secretion of earthy matter is imperfect; the callus is infant bone, of an organization perfect for all the purposes of bone, but as yet delicate and yielding. In its organization it is so far perfect, that when it is hurt, or the bony secretion interrupted, the breach of continuity soon heals, so that the callus becomes again entire, and the process is perfectly renewed.

Yielding of the callus.

It sometimes happens that the callus yields without breaking, as the result of using the limb without care before consolidation is completed. When this has taken place, some derangement of the fractured ends, either in the transverse or longitudinal direction, that did not exist when the patient began to use the limb, is observed. I do not remember ever having met with this in the upper extremity, but I have once seen it in the thigh.

Fracture of the callus.

The callus is occasionally fractured from some accidental circumstance. When this occurs, the limb bends at the seat of fracture, but without any snapping or sharp splintering of the bone and without crepitation. It is chiefly by the change of shape in the limb and its readily bending, that we know it to be broken. When the callus is fractured, many of its vessels are torn through, but others are probably only elongated, as it rarely occurs that the whole substance of the callus is divided.

Fractured callus readily reunites.

In these cases the fracture unites much more readily than at first, and, when we consider the great vascularity of newly-formed callus, its ligamentous toughness, at this period, and the excitement which must follow this partial rupture, and the full and vigorous circulation in vessels accustomed to the secretion of bone, we understand this perfectly;—we see why a fractured callus is more speedily united than a recently broken bone, where nothing is prepared for the generation of new bone.

Hence we perceive that breaking the leg a second time soon after its reunion, is not so grievous a misfortune as might *à priori* be apprehended. In a very ill-reduced fracture it might, perhaps, be regarded fortunate. It was the custom of the older surgeons to snap the limb across the knee, whenever they were not pleased with the shape of it; but this is a practice which is not now resorted to, by men who know their profession, after the union is completed.

It often happened that, when those who were averse to the practice of re-fracturing a bone found a limb united with what they conceived to be a redundancy of callus, they endeavoured to soften it with emollients, or astringe it with styptics; and if the limb was much deformed, either with callus, or in consequence of displacement, surgeons were directed to make an incision, and cut or rasp off the protruding portions—I scarcely need say that this practice is also now entirely exploded.

Further remarks upon the propriety of setting a fracture early.

In a former part of this chapter, I have said that it is the practice of some surgeons to allow a limb to lie on a pillow till the active inflammation has subsided, omitting to make any attempt calculated to keep the bones in their right situation till several days have elapsed from the occurrence of the accident. I observed that adhesive matter is thrown out under active inflammation, which, when moderate in quantity, proves advantageous by agglutinating the soft parts to one another. This agglutination tends to fix the muscles, so as to prevent them from disturbing the fracture, and assists in giving a degree of support to the fractured ends, by rendering the parts more rigid than natural. But when the inflammation is high and long continued, the effusion of adhesive matter is immoderate, and all that is thrown out more than sufficient simply to produce adhesion of the soft parts to one another, and to assist in forming the provisional tumour, is injurious, as it retards the recovery of the patient more or less after the bone is united, as will presently appear. Now the irritation, which is occasioned by the broken ends of the bone when they overlap, or get displaced, keeps up and increases active inflammation; therefore, all such derangements ought to be prevented.

The salutary effects of the effusion of adhesive matter, let me repeat, depends upon its fixing the soft parts to one another, and upon its assisting to form the provisional tumour, by which the fractured extremities are in a measure supported, while the more central parts of the callus are forming. These are advantages which are of sufficient importance to be borne in mind; but they are advantages of which the patient will not derive the full benefit, if the fracture be not reduced before the adhesions are formed, and the broken extremities prevented from becoming afterwards displaced. Why?—because the surgeon who suffers his patient to lie with the bones deranged for eight or ten days after the accident, must break down the adhesions and disturb the formation of the provisional tumour, before he can bring the ends of the bone into proper apposition. Adhesions form again, 'tis true, as a necessary result of the new inflammation which the surgeon's violence has produced; but they are seldom, if ever, so strong and effectual as at first. Then what do we infer from this?—that where this plan is practised, Nature suffers an interruption in the early part of the reparative process, which should be as often as possible avoided. Besides, when the bones overlap, the muscles shorten themselves, and assume a fixed contraction which requires a much greater force to overcome than would be necessary at an earlier period; and the pain which the patient has to endure, under this treatment, must be of course proportionably greater. Such are the objections which I would urge against this practice, as far as respects the adhesive inflammation, the formation of the provisional tumour, and the state of the muscles; but there are other objections not less deserving our consideration.

In the account which I have given of the formation of callus, I endeavoured to show that the deposition of callus commences, in ordinary cases, a few days after the accident; that, at the earlier periods, it is soft, and tender, and consequently easily injured; that, though I have said the injuries inflicted upon newly-formed callus by the displacement of the fracture are again repaired, yet it should be borne in mind, that every such injury must give the patient pain, unnecessarily increase the irritation, and retard his recovery. It appears to me, therefore, that in order to guard against these inconveniences and to facilitate the cure, our business is to reduce the fracture as early as possible, and to prevent the broken extremities from becoming again displaced.

Lest, however, I should be misunderstood upon this point, I would remark, that I do not mean, by the above observations, that a fractured limb should be tightly bound up in splints directly after the accident—no—such a practice may prove painful and injurious; but I wish to state that, from all I have observed, the best practice, whenever it can be adopted, is to place the bones in their proper position, and to keep them from the first from riding, and from pricking and tearing the textures which surround them, by means of some apparatus lightly and judiciously applied.

We will now suppose that every attention has been given to the patient, that union has taken place, and that the callus is strong, and that all we have left to accomplish is the restoration of the functions and powers of the limb.

Restoration of the soft parts.

When we reflect upon the nature of fractures, we perceive that, in many cases, the bellies of the muscles must be considerably torn, that the tendons must be sometimes thrown out of their natural situation, that the nerves become injured or pressed upon, and that the capillaries and absorbents of the part are much weakened in consequence of the injury and the action which is set up after the accident; so that they are not able for some time to resist fully the force of the *vis à tergo*. I have said that fibrin, or as some say coagulable lymph, is thrown out in a larger or smaller quantity, and by it the arteries, veins, nerves, absorbents, muscles, tendons, and cellular substance, are often as it were glued together *en masse*.

In my Observations upon Fractures will be found the cases of persons who recovered the use of their limbs much within the usual period, notwithstanding they were purposely chosen from the worst kind of simple fractures. In those cases I gained some time by causing the bones to unite at an earlier period than they usually do under common treatment; but I have gained also much by my attention to the after-treatment. If a patient is left to himself after the bones are united, it will be many weeks, sometimes many months before he will regain the power of using the limb with freedom.

The adhesions to be broken down.

The surgeon, as soon as he finds the callus firm, should set about breaking down the adhesions which remain among the contiguous textures; to loosen when necessary the tendons and muscles, and give them liberty to play. In doing this, he will give the patient a little pain, but if the patient wishes his limb to be speedily restored, he will not mind a little additional inconvenience, in order that this desirable object might be attained. Friction, passive motion, and warm bathing, *judiciously* employed, are commonly sufficient for this purpose. The sooner the adventitious adhesions are removed the better, for the longer they are allowed to continue the firmer they become in many instances, and the greater is the difficulty in making them give way. As soon as the muscles are loosened by the surgeon, and even while he is using means with this view, the patient should be directed to put them into action, in order that their natural tone and force may be restored. All this may be done while the callus is hardening, before the patient is allowed to bear upon his limb, so as to exert much force upon the bone.

Removal of the swelling.

The swelling of the limb which is observed after the union has taken place, arises principally from the presence of fibrin, which is thrown out soon after the accident, and from serum which exhales from the weakened capillaries, and in part sometimes by the exuberance of callus. The first may be removed by friction and bandages. Bandages will also prevent the gravitation of the serum; support the capillaries, and enable them to acquire their natural functions, so as to prevent the serum from escaping. Where there is an exuberance of callus, we may excite the absorbents to more vigorous action, by the application of a stimulating plaster; but, whether we apply any thing or not, Nature will in time take away the superfluous quantity of ossific matter and round of the projecting points of bone; so that, if the fractured ends be properly joined, the limb will become as shapely and useful as before.

In the two chapters which have brought me to the conclusion of my general remarks upon fractures, I have endeavoured to steer clear of every thing which has not some bearing upon practice, and every thing but what is advisable that every scientific surgeon should be acquainted with. We should know what a fracture is; we should know the causes of fractures; the symptoms by which we may distinguish them from other injuries; the different kinds of fracture; the different kinds of displacement to which fractures are subject; and the causes of such displacement; and should not be ignorant of the probable results: we should make ourselves acquainted with the effects of fracture upon the surrounding parts; the reasons why fractures unite more speedily in the young than in the old; the manner in which union takes place; the effects of injury upon the callus; and the treatment which the limb requires after the consolidation of the fracture is effected. All these I have attempted to explain; and we shall now be prepared to enter upon the investigation of particular fractures, which we shall commence in the following chapter.

ON THE

NATURE AND TREATMENT

OF

PARTICULAR FRACTURES.

CHAP. III.

THE CAUSES, SYMPTOMS, AND NATURE OF FRACTURES OF THE UPPER THIRD OF THE THIGH-BONE.

SEC. 1.—*The Classification of Fractures of the Cervix Femoris.*

Mode of treating this subject.

THE profession has, within these few years, been favoured with much important information upon fractures of the cervix femoris, to which I must frequently allude in the course of my observations upon this subject. Those points which, as far as I know, are original with myself, I shall incorporate with the observations of other surgeons, in order to place this, perhaps the most difficult, part of my undertaking, as clearly before the profession as circumstances will allow.

Sir Astley Cooper's division of fractures of the neck of the thigh-bone.

Sir Astley Cooper has divided fractures of the neck of the thigh-bone into two kinds, each dependant upon the situation of the fracture; those fractures which are altogether within the capsular ligament forming one kind, and those which are external to it the other.

The author's views on the division of fractures of the neck of the thigh-bone.

I agree with Sir Astley in the propriety of this division, as far as it goes; but I think it is of practical importance to consider fractures of the cervix femoris which occur within, and those which occur external to the synovial capsule, in the same manner as fractures in the middle or any other part of the bone, as far as respects the particular state and direction of the fracture. Hence it will appear that, according to the view which I take of fractures generally, each of the kinds mentioned by Sir Astley Cooper advantageously admits of a subdivision. Those fractures which occur entirely within the synovial capsule might be divided into fractures without any considerable laceration of the close coverings of the neck of the bone, and into fractures accompanied with an extensive laceration, or complete division of these coverings. Fractures external to the capsule might also be divided into two kinds, one of which is accompanied with little or no laceration of the investing soft parts, and the other with great laceration, or complete division of them.

Division of fractures into incomplete and complete.

Fractures of the neck of the thigh-bone might be incomplete, by which I mean, as I have elsewhere described, that the bone is not entirely divided; or they may be complete, by which I understand a complete division of the osseous structure.

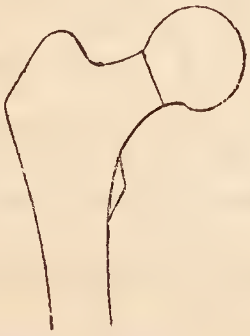
Varieties of incomplete and complete fracture.

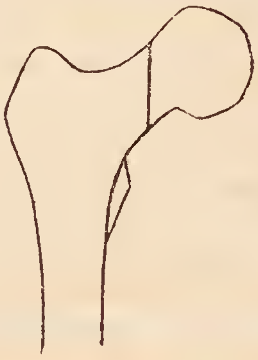
Incomplete or complete fractures might be transverse, oblique, or comminuted. Incomplete transverse fractures, however, will probably be seldom met with in this part of the femur; but as the possibility of their occurrence cannot I think be doubted by scientific surgeons, I see no objection to the admission of such fractures in this arrangement. Incomplete oblique fractures are easily produced in recently dead bones, and though we might not be able to distinguish them, with certainty, during life, from various affections of the hip-joint, they occasionally occur from the operation of causes which produce them in other situations. Incomplete comminuted fractures might also be easily produced after death, and they are sometimes occasioned during life, by the force of some projectile, as a musket-ball.

Sec. 2.—*Fractures of the Cervix Femoris, within the Synovial Capsule, unaccompanied with any considerable Laceration of the investing Membranes.*

Complete fractures of this part.

When a complete fracture within the capsule of the joint is transverse, it is usually situated close up against the head of the bone, *(a)*. When it is oblique, it might pass through the bone in different directions, but the most common direction that it takes is downward and outward, *(b)*. Complete fractures of this part are sometimes comminuted.





Observations, shewing that such fractures may occur.

Some surgeons might be inclined to doubt the possibility of fractures occurring within the synovial capsule, without any considerable laceration of the close coverings, in consequence of their tenuity. This opinion, however, is not founded upon any hypothetical speculation, but upon the more solid basis of analogy, experiment, and fact.

Analogical proof.

From analogy, we are led to believe, that fractures of the neck of the thigh-bone within the capsule, may take place without any considerable division of the periosteum and reflected membrane, because we find, that fractures occur in other situations with but little laceration of the periosteum. The only thing which is to be observed between fractures of the cervix and those which occur in other situations, as far as regards this question, is, that the reflected membrane and periosteum covering the neck of the bone, will probably, in general, allow of being more easily lacerated than the periosteum covering the middle of the bone, in consequence of being unsupported by the attachment of muscles.

Proof from experiment.

From experiment, we should conclude, that fractures of the cervix femoris might occur in the living, without any considerable laceration of the close coverings of this part of the bone, because we can readily produce them in bones recently dead.

Fractures of this description have been met with.

Many facts, derived from the actual inspection of the parts after death, might also be adduced, to show that such fractures do actually occur in the living.

The age of persons most subject to fractures within the capsule.

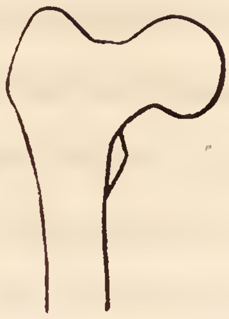
The fractures of which I am now speaking, in common with those accompanied with laceration of the close coverings, occur *principally* in people above the age of 50 years.

Predisposing causes.

Old people are particularly predisposed to fractures of the neck of the femur, especially within the capsule, in consequence of the change which it frequently undergoes, after the middle period of life. The internal part of the head and neck of the bone sometimes becomes of a loose cancellated structure, covered by a thin shell of bone; often so soft that it might be cut with a common knife.

Unnatural direction of the cervix.

Occasionally this altered condition leads to an unnatural direction of the cervix, with respect to the shaft of the bone, which facilitates still more the occurrence of fracture. The head of the bone, in some cases, is gradually driven down by the superincumbent weight of the body, so as to bring the neck to a right angle with the shaft, *(a)*. Now and then, in very advanced age, the head of the bone is depressed, so as to occupy a situation even lower than that part of the neck which joins the trochanters, *(b)*.



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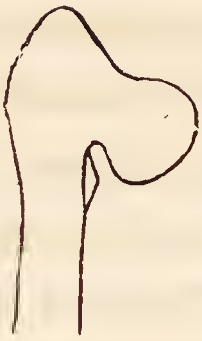

b

The immediate causes of fracture in this part.

The immediate causes of fractures of the neck of the thigh-bone in old people, especially those which occur within the capsule, are often very slight, such as a slip of the foot from the curb-stone down upon the carriage road, when the weight of the body is upon the slipping limb; slight falls upon the trochanter; trips in the act of walking, &c.

Diagnosis in fractures without laceration.

The diagnosis of these fractures, when unaccompanied with laceration, is extremely difficult; but as it is of great importance that this should be discovered, those symptoms by which, it seems to me, we should be guided, require our particular attention.

The symptoms of this accident not always strongly marked.

The symptoms which accompany these injuries, as far as I have been able to determine, are few, and these, I am sorry to say, are by no means prominent. Notwithstanding the existence of a fracture of this description, the patient might be able to exert considerable power in the limb. He might be able to bend it upon the pelvis, or to roll it inward immediately after the accident; not however without giving himself pain. There is but little or no shortening of the limb. The foot may or may not be everted. We may or may not be able to elicit crepitus. Hence it will appear, that the two most striking symptoms which accompany a fracture of the cervix femoris *with laceration* do not exist, or at most very slightly, while the close coverings remain entire, and the neck of the bone continues of its natural length. The reason of this will immediately appear, when we consider, that the retentive power of the periosteum and reflected membrane being entire or nearly so, prevents the fractured ends from being much displaced, and, at the same time, in a very great measure, prevents eversion of the foot; and, in consequence of the great facility with which the head of the bone moves in the acetabulum, crepitus will seldom be produced. In order that the crepitus of fracture should be rendered evident, it is necessary that the broken surfaces should be made to rub upon each other. This cannot sometimes be done, in these accidents, without much difficulty;

for the head of the bone moves readily in the acetabulum, upon receiving the slightest impulse; and this motion of the head of the bone cannot always be restrained, especially when the investing membranes are but little torn; consequently, when the shaft of the bone is moved, the head of the bone commonly moves with it simultaneously; and when this is the case, in the same relative degree, crepitation is never felt.

Those most to be depended upon.

The symptoms of this accident, then, are confessedly obscure. We must depend, in a great measure, upon the history of the case, into which we should inquire most minutely. A great and sudden diminution of power in the limb, referred principally to its upper and inner part, and occurring immediately after the infliction of an injury, of that description which usually produces fracture of this part, must be regarded as a symptom of considerable importance. There is a tenderness in the joint, and some pain experienced in the soft parts in the direction of the pectineus muscle and the tendon of the psoas magnus and iliacus internus, and sometimes in the hollow behind the trochanter. The patient may be able to turn the limb inward or outward; he may be able to bend it upon the pelvis, but not without pain, and a remarkable sense of weakness in the joint. The close coverings may yield so as to allow of slight eversion and slight shortening of the limb. The swelling in these accidents is not likely to be great, unless the surrounding parts are much injured by the blow, or other force, which occasioned the fracture. That which occurs is confined principally to the joint. When these symptoms exist, we might, I think, fairly suspect the existence of a fracture; but, in order to make ourselves more certain, we should examine the limb very attentively. This should be done, however, with the utmost caution.

Knowledge requisite to enable the surgeon to examine the limb with safety to the patient.

We must remember that the fractured ends of the bone, in this accident, are held together by the periosteum and reflected membrane, which are placed in close contact with the bone at the seat of injury. These are in extreme danger of laceration, if the limb be roughly handled, or incautiously moved by the patient or his attendants. The periosteum and reflected membrane possess but little sensibility in the healthy state; hence it will appear that, before inflammation comes on, much mischief might be done to them, without a comparative expression of pain on the part of the patient. In order to guard against this evil, we should know in what position of the limb the periosteum and reflected membrane are most likely to be put upon the stretch. When we are in possession of this knowledge, the course to be pursued is simple and easy. The mode in which the manual examination is conducted, might materially influence the result of the case; and, as I am not aware that any author has given directions upon this subject, I shall be excused for dwelling a little upon it in this place.

The effects of bending the limb upon the pelvis—of bearing upon it—of extending it.

When a patient is placed upon his back in the horizontal position, and has the limb, in a natural state, bent upon the pelvis, the superincumbent weight of the limb is thrown upon the acetabulum; but when a fracture exists in the neck of the bone, the weight of the limb is not propagated along the bone to the acetabulum uninterruptedly, as when the bone is entire, but is received by the close coverings of the cervix at the breach of continuity, from which it passes to the pelvic portion of the bone, and is then received by the acetabulum. Here we see that when there is a solution of continuity in the neck of the bone and the limb is bent upon the pelvis, the principal part of the weight of the limb is thrown upon the periosteum and reflected membrane, before it reaches the acetabulum.

These coverings are, therefore, put upon the stretch, and consequently pain is experienced by the patient, if the limb be strongly bent upon the pelvis. Again, when a fracture exists in the neck of the bone, without any considerable laceration of the close coverings, the femur, in the different movements of the limb, acts upon these coverings with the advantage of a long lever; and, unless great care be taken, they are in danger of being completely divided. It is worthy of remark, that this stretching effect, experienced by the periosteum and reflected membrane, is produced quicker when the limb is bent upon the pelvis while it is inverted and adducted, than when it is everted and abducted. The reason of this is evident. In bending the limb, so as to make it form with the body an acute angle, it meets resistance quicker, or by moving through a smaller space in the first instance than in the second, because the upper and anterior part of the acetabulum forms a fulcrum to the femur, which does not happen when the limb is bent upon the body in the abducted and everted position; and, hence we find, that a patient with a fracture of the neck of the thigh-bone, always experiences more pain when the limb is bent upon the pelvis, with the foot everted and adducted, than when it is moved in any other direction. If the limb be forcibly extended, or the patient attempt to bear upon it, the close coverings are also stretched, and the patient consequently complains of an increased degree of pain, at the upper and inner part of the thigh.

Crepitus.

Crepitus, which must be regarded as the most unequivocal sign of fracture, might or might not be produced; for, as I have said, the head of the bone moves so readily in the acetabulum, that the least impetus, even through the periosteum and reflected membrane, will cause it to move simultaneously with the shaft; and if it should do so in the same relative proportion, crepitus cannot be felt. If crepitus be not elicited by bending the limb upon the pelvis, the surgeon may try to produce it, by causing the limb to be *gently rotated,* while he endeavours to fix the head of the bone, by pressing it, with his fingers, back against the acetabulum.

Summary of the symptoms of this accident.

If I may be allowed to sum up the symptoms of this accident, I may state, as far as my observation will, at present, enable me to decide, that the patient feels, immediately after he has sustained this injury, a remarkable diminution in the powers of the limb. He feels pain at the upper and inner part of the thigh, especially in the line of the tendon of the psoas magnus and iliacus internus, which is increased when the limb is made to bear a part of the weight of the body; and sometimes when the limb is extended in a straight line with it; or when it is bent upon the pelvis, and at the same time rolled inward. He experiences tenderness in the joint when it is pressed upon. Crepitus is sometimes felt; and there is, occasionally, a slight degree of retraction and eversion of the limb.

Having mentioned the causes of this fracture, the age at which it most frequently occurs, as well as the symptoms, as far as I have been able to ascertain them, I shall go on to the consideration of the manner in which the parts are nourished, both before and after the accident; and shall endeavour to show the difference between a fracture of the cervix femoris within the synovial capsule, when unaccompanied with laceration of the close coverings, and a fracture of the middle of the bone, as far as it regards the reparative process.

It will be recollected, that arteries supplying the head and neck of the bone with blood for their nourishment and reparation, ramify in the periosteum and reflected membrane, in a direction from the trochanters to the head of the bone, as might be seen in *Fig. a,* where they are represented in an injected state;

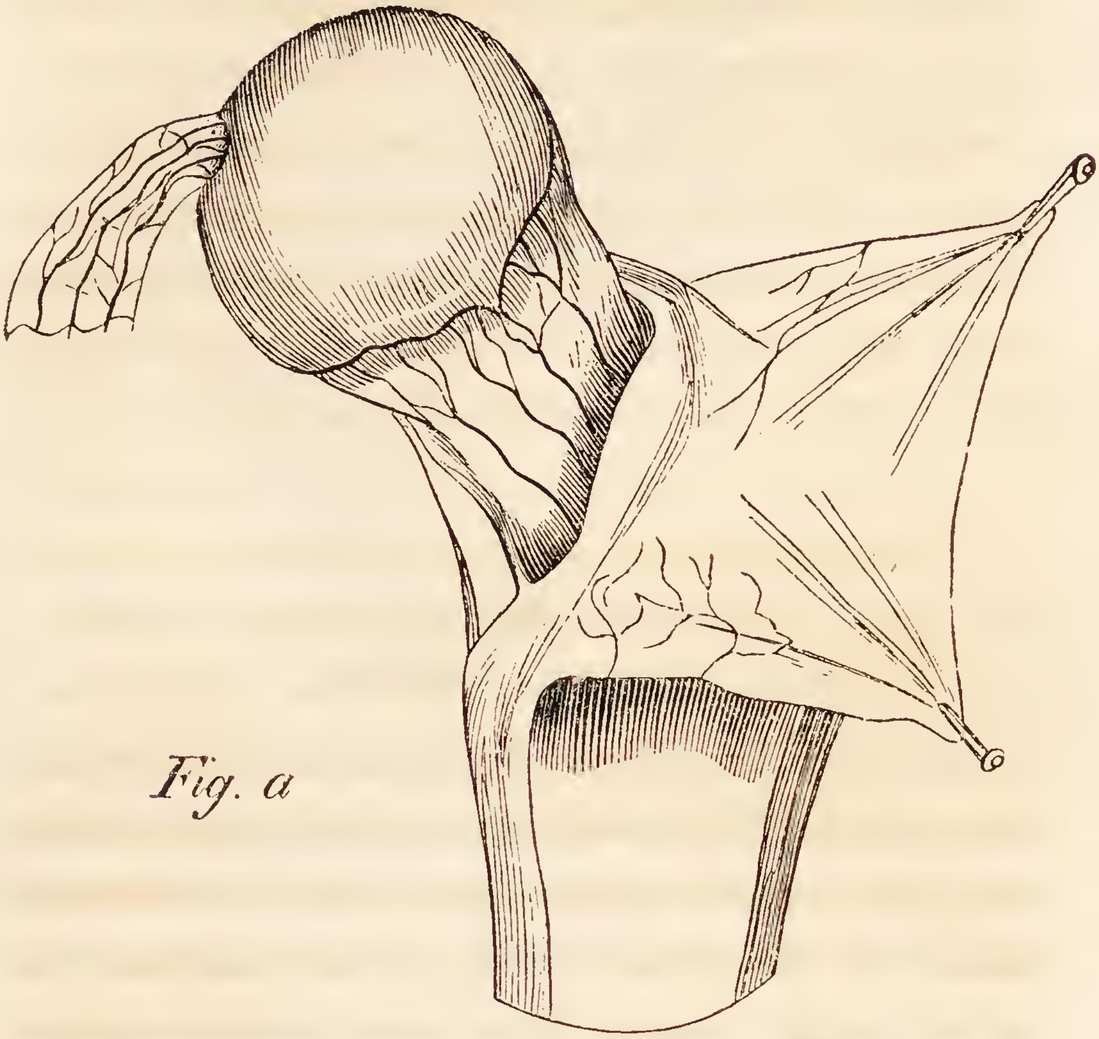

Fig. a

and that branches are sent into the bone from the periosteum and reflected membrane, which take the same direction, *viz.* from the trochanters towards the head, as in *Fig. b,* (p. 94,) which represents a section of an injected femur, with part of its capsular and round ligament attached.

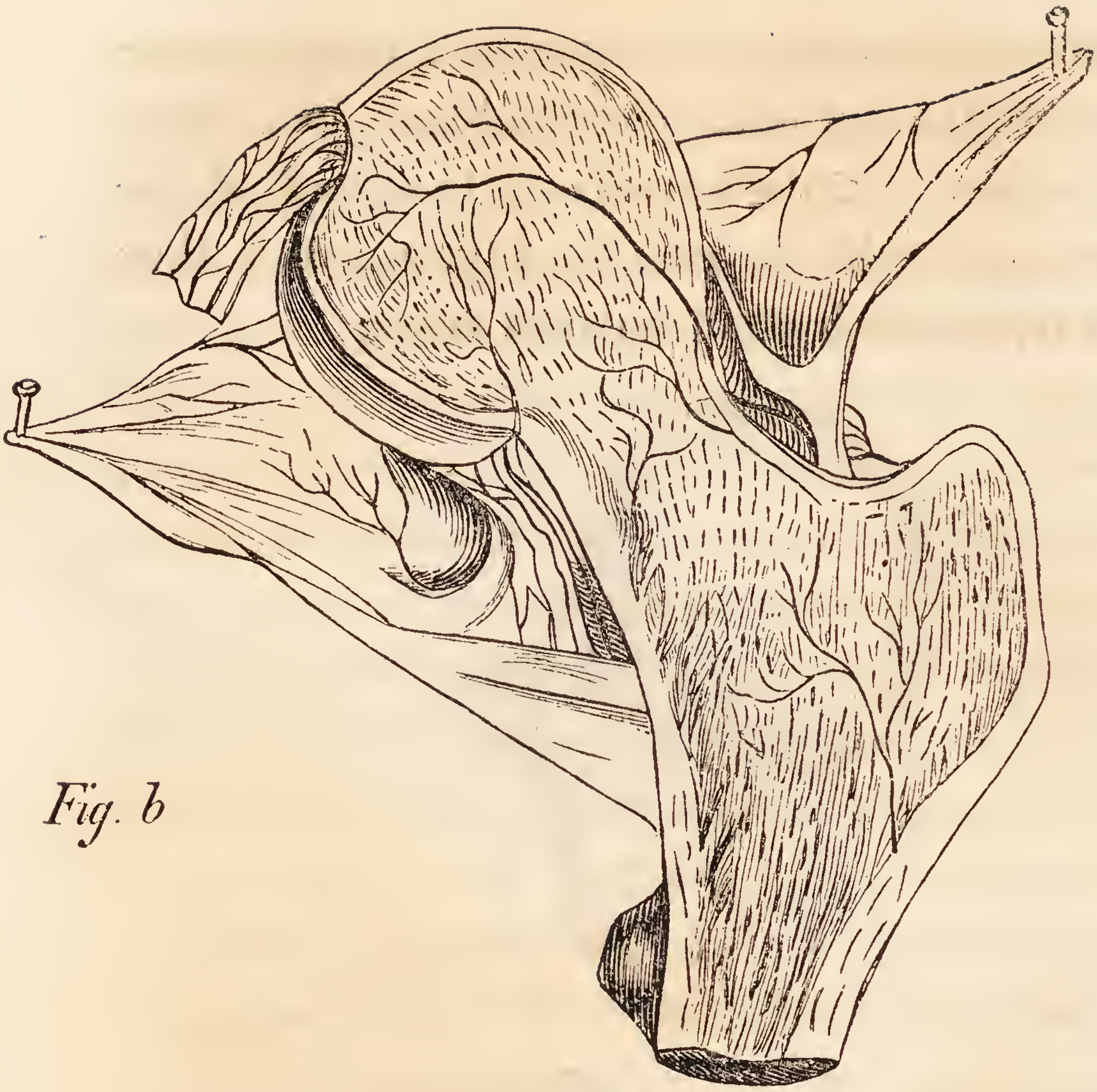

Fig. b

The arteries which pass into the ligamentum teres and which are destined principally for its support, may convey a very small quantity of blood to the head of the bone; but they are so extremly minute that we cannot suppose, that the head of the bone derives any considerable portion of its nourishment from this source. What, then, is the difference in the mode by which nourishment is conveyed to the head and neck of the thigh-bone within the capsule, and that by which the other parts of the bone are nourished? It will be seen that, if we leave out of our consideration the minute arteries of the ligamentum teres, we have only one source of nourishment, which is the arteries that go to the head and neck of the bone, in a direction from the trochanter towards the pelvis; some of which penetrate the capsular ligament and ramify beneath the reflected membrane to the head of the bone sending off branches in their course, which pass into the bone and take the same direction; and other very small branches go to the neck of the bone, from those which ramify in that part of the substance of the bone, which is external to the capsule.

The effect of fracture upon the vessels in the substance of the bone.

This being the manner in which the head and neck of the bone are nourished, what will be the effect of a complete fracture of the neck within the capsule, upon those vessels which pass to the head of the bone through the substance of the neck? It is evident, that the arteries which enter the bone on the trochanteral side of the fracture, will be divided, as in *Fig. c*, (p. 96;) consequently, a very considerable portion of the nourishment, which would otherwise be conveyed to the pelvic portion, will be cut off.

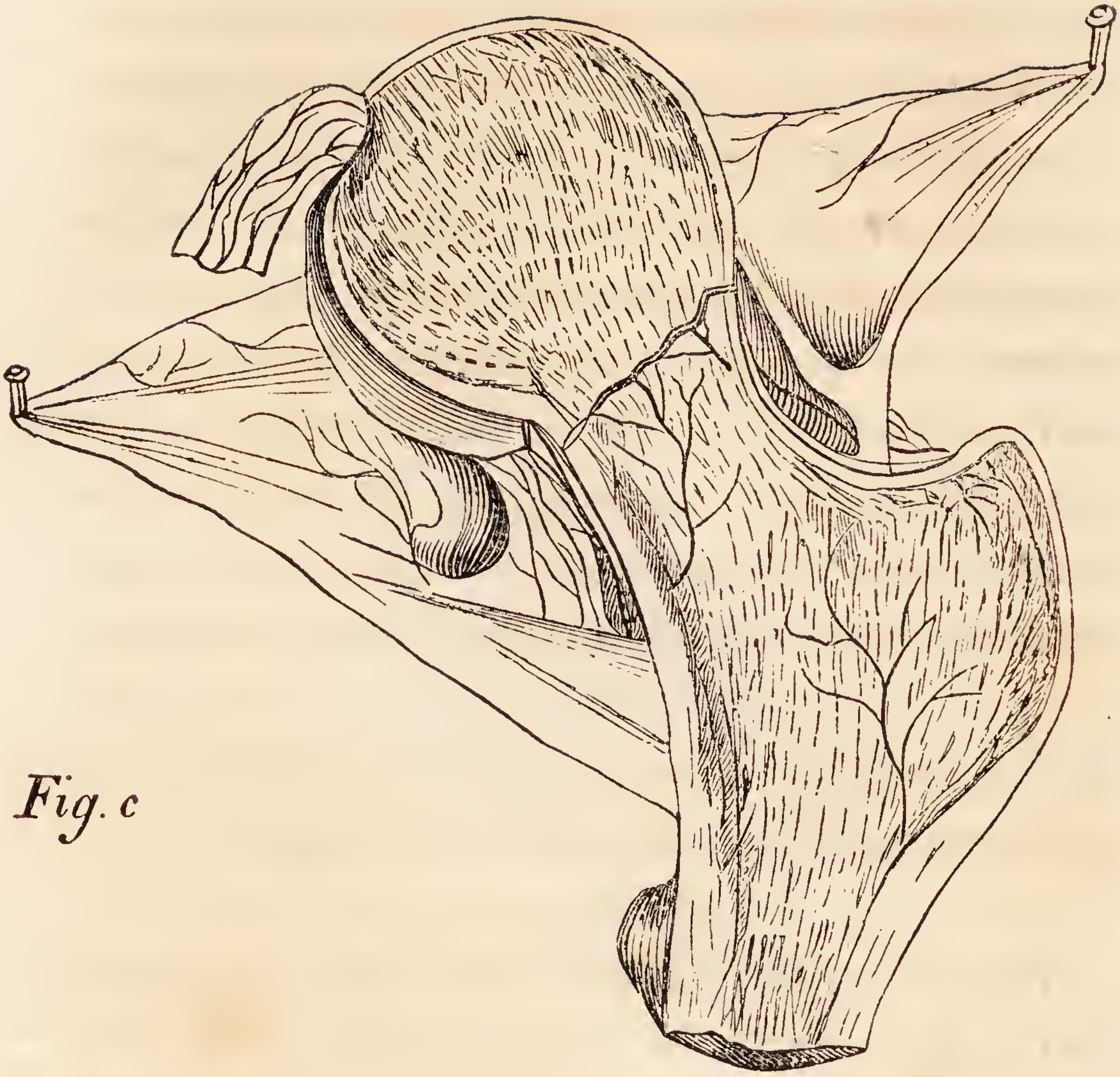

Fig. c

From this we see that the pelvic end of the bone is placed under circumstances somewhat different from a fractured end of a bone in any other situation external to a capsule, even when the fracture is of the favourable kind, of which we are now speaking. In what respect? The fractured ends external to a capsule are pretty equally supplied with blood, in consequence of arteries being equally distributed, or nearly so, through each of the fractured ends; which is not the case when a fracture of the neck of the bone exists, within the synovial capsule.

We have now to consider how far the diminution of the quantity of nourishment, naturally sent to the pelvic portion of the bone, in consequence of the laceration of the arteries within the substance of the neck, may influence the reparative process; and whether there are any circumstances in the vital condition of the fractured ends, that render union by bone in such cases physically impossible; and why it is that fractures of this kind are so seldom found united.

Is the division of these vessels sufficient to prevent osseous union?

It is a general law for fractures to unite, more or less rapidly, according to the quantity and capacity of the blood-vessels that supply the fractured parts. In the young, the arteries are large and numerous, and in them we find the union of a fracture speedily effected; in the old, they are smaller and much less abundant, and consequently, the uniting process in them is comparatively tardy. Let us apply this law in the kind of fracture which we are now considering. I have said, that the bones of old persons unite much more tardily than those of young; occasionally they take double, sometimes treble the time in uniting, and that the cause of this, is the diminished quantity of blood sent to them. Now, the fracture of which we are speaking, occurs principally in old people, in whom the blood is scantily sent to the bones; and the fracture renders this supply to the head of the femur still less, by tearing through a portion of the vessels, which go to the pelvic portion. What is the evident inference to be drawn from these facts? That, as there is in the pelvic portion a less supply of the pabulum, which is necessary for the production of the uniting medium, the process of union must be retarded, as an edifice takes a longer period in building when the labourers are few, or the materials supplied but slowly; but we must not consider from this, that a fracture thus situated, can never unite, any more than we may infer, that an edifice so circumstanced, could never be built. Notwithstanding the vessels in the substance of the bone are torn through, there are yet left entire the majority of those that pass over the fracture, as they ramify in the periosteum and reflected membrane, in their way to the pelvic extremity or head of the bone; consequently, a considerable supply of blood is still sent to the pelvic portion. Here a question naturally arises—whether this supply, added to the small quantity which the head of the bone may derive through the arteries of the ligamentum teres, and that which it obtains by a renewed arterial communication between the fractured surfaces, be sufficient to prodcue a bony deposite from the fractured end of the pelvic portion? The number and size of these vessels would lead us to conclude, *à priori*, that they are sufficient for this purpose; and that they are so, is rendered evident by the appearance of the fractured end, which, after a time, becomes smooth, and also denser than natural.

Is the presence of synovia between the fractured surfaces sufficient to prevent union?

There are other circumstances attending this variety of fracture, which, it might be said, have an influence in preventing the process of osseous union. The only one, however, which appears to me to bear upon the *physical* possibility of union is the effect of the synovia. If any portion of the periosteum and reflected membrane be torn through in the slightest degree, which it is probable they will be in every case, the synovia will get between the fractured surfaces of the bone; and it might seem, that its presence would prevent the bony matter, thrown out from the opposing ends, from coalescing, and that, consequently, bony union would not take place, even though a large quantity of callus be deposited. Granting, however, that the synovia might have some effect in preventing union by bone; yet we have abundant evidence to prove, that its influence is readily overcome in other situations.

Its influence is readily overcome in other situations.

When a fracture extends in an oblique direction from the trochlea of the os humeri to just above the inner or outer condyle, the synovial membrane must frequently be more or less torn, and when it is lacerated, the synovia readily insinuates itself between the fractured surfaces ; but we do not find that its presence in such cases prevents the fracture from uniting. The same might be said of fractures extending into the knee-joint, or into the ancle-joint ; and I see nothing which would lead me to infer, that the influence of the synovia in fractures of the neck of the thigh-bone within the capsule, is such, as to make them of itself an exception to the law which is found to obtain in the union of fractures extending into other joints.

Inference respecting the physical possibility of union by bone.

It appears to me that, as far as regards the physical or vital condition of the parts, there is only one circumstance which in any way tends to make the prognosis more unfavourable in fractures of the neck of the thigh-bone, within the synovial capsule, when the close coverings are but little injured, than in fractures extending into other joints, which is the division of the arteries that go to the head of the bone, through the substance of the neck; and this is not, in my opinion, sufficient to render it physically impossible that union should take place.

The principal cause of non-union in these cases.

I am well aware that, under the ordinary treatment, the fractured ends are not kept in a state of quietude; and that the degree of motion which is allowed to take place in these fractures, is often sufficient to prevent union in fractures much more favourably situated. It will, however, be perceived, that this impediment to union is referable to the imperfection of the mechanical means resorted to, rather than to the nature of the injury, for the cure of which they are employed. From the view which I take of this subject, the cause of want of union which is observed in these cases, is not physical, but mechanical;—the fault lies at the door of surgery, and not in the nature of the accident.

The close coverings are sometimes lacerated after the accident.

In the course of the preceding observations, I have laid great stress upon the importance of the periosteum and reflected membrane, as a medium through which nourishment is principally conveyed to the head of the bone when there is a complete fracture of the neck within the capsule, unaccompanied by any considerable laceration of these coverings ; now it sometimes happens that, though these coverings shall not have been much lacerated by the accident, they are torn through after it, either by the incautious movements of the patient, or the improper handling of the attendants. This is likely to occur when the weight of the body is thrown upon the limb, as might be the case when this fracture happens to a person in a state of intoxication ; or when the attendants are careless in removing the patient from place to place ; or it might be produced even by the surgeon himself, if he be ignorant or incautious, in conducting his examination of the limb.

This has been observed by several surgeons.

That such an accident might occur must be evident, when we consider the thinness of these coverings, and the nature of the surfaces which are opposed to them—I mean the serrated edges of the fractured ends of the bone. The structure and state of the parts favour such an opinion, and though we were less able to explain the fact, we should not, I think, be less constrained to receive it. Sabatier states, that he has seen this occur as late as the twenty-third day after the accident. I have seen three cases in which retraction took place in a few days after the accident. This, in fractures within the capsule, can, it seems to me, only be accounted for upon the supposition that the investing membranes had then become more extensively lacerated, or perhaps, entirely torn through by the incautious manner in which the parts were examined, or by some other equally efficient cause.

Division of the close coverings in consequence of absorption produced by pressure.

I am disposed to believe, however, that the periosteum and reflected membrane are sometimes divided by the operation of causes which are not under the control of the patient; and which are quite independent of any awkward management on the part of the attendants. We know that when any part of the body is unnaturally pressed upon, and the pressure continued for a considerable period, it becomes thickened or absorbed; according to the degree of pressure exerted, and the power of the part to bear it. If the pressure be slight, and the power of the part strong, Nature builds up a barrier against the inconvenience; this we see well exemplified in the formation of a common corn; but if the pressure be great, and Nature finds she cannot protect herself against it by adding layers of defensive matter, she effects the removal of a portion of the part, in order to facilitate her future operations. We see the pressure of tumours produce absorption of the bodies of the vertebræ of the ribs and other parts. May we not then, by a parity of reasoning, apply this law of nature with great propriety in the consideration of fractures of the neck of the thigh-bone? We know that, in these cases, the keen and irregular edges of the fractured ends are constantly forced by the action of the muscles against the periosteum and reflected membrane, when they happen to escape laceration, at the time of the accident; what, then, should we infer would be the result of such constant pressure, as is kept up by those strong muscles which tend to retract the limb, and force the fractured ends against these coverings? It seems to me, that if such pressure be allowed, it will be likely to effect a speedy absorption of the periosteum and reflected membrane in the situation of the fracture, and this absorption will be hastened by the friction which takes place when the patient moves; and what would be the immediate consequence of a division of these coverings thus effected? Retraction of the limb. This perfectly coincides with what takes place in other parts. If, in an oblique fracture of the leg, the bones are suffered to overlap, the riding is much greater a few days after the occurrence of the fracture, than within the first few hours.

This difference arises from absorption, or from laceration of the contiguous textures after the accident, in consequence of the motion of the fractured ends of the bones ; for the muscles very soon retract the lower portions of the bone, as far as the first laceration of the soft parts will allow, and then the whole are pressed by the action of the muscles against the contiguous textures, which must be frequently torn in parts by the ends of the bones, and in others they are gradually removed by absorption ; and the fracture rides in the same proportion, till the action of the muscles is resisted, and the ends of the bones prevented from any considerable extent of motion, by the adhesions which take place in the fracture, or by other means. One might at first suppose, that adhesions would as speedily take place in fractures of the neck of the thigh-bone within the capsule, as in those which are exernal to it ; but, on further consideration, it will appear, that the adhesions which are produced between the fractured ends of the cervix within the capsule, will be much more slowly effected in consequence of the injured parts being so little assisted in producing them by those which surround the bone in this situation.

Inference.

Thus, then, we see that a fracture of the neck of the thigh-bone within the capsule, which at the time of the accident might have been of the most favourable kind for osseous union, may so far have the periosteum and reflected membrane injured by the improper management of the attendants, or by the motion of the broken surfaces arising from the movements of the patient, or by absorption in consequence of pressure, or by all these causes operating at one or at different periods, as to be converted into the state of a fracture, which, from the first, is of the most unfavourable kind for bony union, of which I shall treat in the next section.

SEC. 3.—*Fractures of the Cervix Femoris within the Synovial Capsule, in which the close Coverings of the Bone are nearly or quite divided.*

The causes of these fractures.

The predisposing and immediate causes of fracture of the neck of the thigh-bone within the synovial capsule are the same, whether the fracture be or be not attended with a division of the periosteum and reflected membrane.

The symptoms.

The symptoms of this accident, when accompanied with a division of the close coverings, are much more strongly marked than in that where they remain nearly or quite entire; and, with few exceptions, are the same in all cases. When the fracture of which we are now speaking exists, the retraction of the limb is usually from three quarters of an inch to an inch and a half; commonly, however, in the recent state of the injury, it is not more than an inch. There is eversion of the foot, attended with great diminution of the powers of the limb; the patient, however, is still able to roll it inward, frequently so far as to bring the foot from its everted position high enough to place the limb in that position which might be called supine, or in which the ball of the great toe and the superior anterior spinous process of the ilium are in a straight line with the long axis of the body. The patient can also bend the limb a little upon the pelvis, but not without great pain, when the fracture is in the recent state. He experiences pain opposite the insertion of the psoas magnus and iliacus internus, which is increased when the limb is bent upon the pelvis, especially when it is, at the same time, adducted and inverted. The limb might be readily drawn down to its proper length, but, as soon as the extension is discontinued, it becomes again retracted; and might be passively moved in every direction, but not without producing pain. When the limb is rotated, the trochanter, instead of moving in a circle, is observed to roll, as it were, upon a pivot. Crepitus may generally be felt when the limb is drawn down, and then rotated, while the head of the bone is fixed firmly in the acetabulum, by pressing upon it with the fingers over the front of the joint.

The foot sometimes inverted.

It sometimes happens that this accident is accompanied by an inverted position of the foot. In the second part of the thirteenth volume of the Medico-Chirurgical Transactions, Mr. Stanley has mentioned a case, the only one, I believe, on record, in which there was inversion of the foot attending a fracture entirely within the capsule of the joint.

" A middle aged man fell in the street, and his hip struck the curb-stone. The immediate consequences were, that the limb was inverted and shortened to the extent of an inch, and no crepitus could be discovered. It was presumed that a dislocation had occurred, and accordingly an extension of the limb was made, and so great was the constitutional irritation occasioned by the repeated trials to reduce the supposed dislocation, that the man died about five months from the time of the accident. In the dissection of the hip a fracture was found extending obliquely through the middle of the neck of the femur, but entirely within the capsule. A portion of the fibrous and synovial membrane on the anterior side of the neck of the bone had escaped laceration."*

The causes which gave rise to the inverted position of the limb in this instance are evident.

The foot is occasionally upright.

The foot is occasionally upright. I have seen only one instance of this, and am disposed to attribute the position which the limb assumed, in this case, to an entire state of a portion of the investing membranes on the anterior and posterior parts of the neck. These slips of the synovial and fibrous coverings might be separated from the bone sufficiently to allow of retraction to the extent of an inch or more, as might be seen in a preparation now in my possession.

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* The same position would be likely to occur if the fracture of the cervix, in this situation, were accompanied with a fracture separating the trochanters from the shaft of the bone.—*Author*.

No one position constant.

Hence it appears that no one position of the limb can be considered as an invariable attendant on fractures of the neck of the thigh-bone, even when they are accompanied with laceration of the investing soft parts. Eversion of the foot, however, is almost always present when the fracture is in the neck only; and when the limb assumes any other position, it seems to me that it might be fairly attributed to the direction and seat of the fracture, and the peculiar laceration of the surrounding parts, which might take place at the time of the accident, or subsequently to its occurrence.

The cause of the pain felt upon rotating the limb.

The increase of pain which is experienced on bending and rotating the limb, when the close coverings are torn through, arises principally from the friction of the serrated edges of the fractured surfaces against the loose and inflamed portion of the capsule of the joint; and not from any injury inflicted upon the synovial and fibrous membranes naturally investing the bone, as when these membranes are not divided.

Crepitus cannot always be elicited.

It often happens that crepitus is not discovered, even when the other symptoms are so evident as to leave no doubt of the existence of a fracture. This is sometimes to be attributed more to the manner in which the examination is conducted than to the nature of these cases. I have frequently seen surgeons attempt to produce crepitus without drawing the limb down to its natural position; and, after twisting it about for a considerable time, they have pronounced that crepitus could not be felt. It is not to be expected that crepitus will be elicited by such a mode of examination. In order to enable us to produce crepitus, the limb should be first extended, with a view to bring the fractured surfaces into contact; and then rotated, while the head of the bone is fixed in the acetabulum by means of the fingers. The surgeon should place one hand upon the head of the bone and the other upon the trochanter major; and should press the head of the bone back against the acetabulum, while the assistant extends the limb and gently rotates it. As far as I can find, surgeons had overlooked the important advantage which is gained by fixing the head of the bone. I am not aware of any author who mentions it, nor of any surgeon who practises it, except those who have received the idea either directly or indirectly from myself. Still, however, it must not be considered that crepitus might be discovered in every instance, even under the most judicious examination. For, in some cases, it is impossible to command the pelvic portion, so as to ensure sufficient apposition of the fractured surfaces to allow of the production of crepitus. The head of the bone might be turned round in its socket, so as to place the fractured surface of the pelvic portion of the neck out of the way of that portion which is attached to the trochanter; and, when this happens, the latter will be brought into contact with a natural surface; and consequently, when the fractured surfaces are thus relatively placed, crepitus is not likely to be occasioned by rotating the limb, even when the head of the bone is prevented from moving. There is, then, in my opinion, two reasons to be assigned for the occasional absence of this symptom, even when the limb is judiciously examined: 1st. The great mobility of the head of the bone, whose motions cannot always be controlled, especially in fat persons; and, 2d. The contact of a natural and a fractured surface, which does not allow of the production of the crepitus of fracture.

Question as to the possibility of producing bony union in these cases.

It is a question at present agitated, whether in this variety of fracture, union of the fractured surfaces can be effected, by the interposition of osseous matter? The opinion which now very commonly prevails, is, that a fracture of the neck of the thigh-bone, accompanied with considerable laceration, though it might not amount to a complete division of the close coverings, cannot be made to unite by bone. This opinion, promulgated by a gentleman whose professional acquirements I shall always respect, has led surgeons, in general, to abandon these cases to the operation of Nature, and hence we find, that a very numerous class of accidents—so numerous, indeed, that our hospitals are seldom free from them—are regarded as beyond the reach of surgery. As I cannot subscribe to this opinion, nor to the practice of leaving such patients to their fate, I shall, I hope, be excused for entering into this subject a little more minutely, and for investigating, somewhat critically, the arguments of that gentleman, who is the principal supporter of the doctrine of non-union.

The mode in which the head of the bone is nourished, when the fracture is accompanied with laceration of the investing membranes.

When a fracture occurs in this situation, without laceration of the close coverings of the cervix, the arteries which go to the head of the bone through the substance of the neck, are, as I have said, torn through, and the vessels which principally supply the head, are, in such cases, conveyed to it over the fracture in the periosteum and reflected membrane; but when the variety of fracture now under consideration exists, not only are the vessels which pass to the head of the bone through the substance of the neck divided, but also those which go to it in the periosteum and reflected membrane, in consequence of the laceration of these coverings. The state of the parts which is observed in these cases I have attempted to represent in the accompanying diagram. *(Fig. d.)*

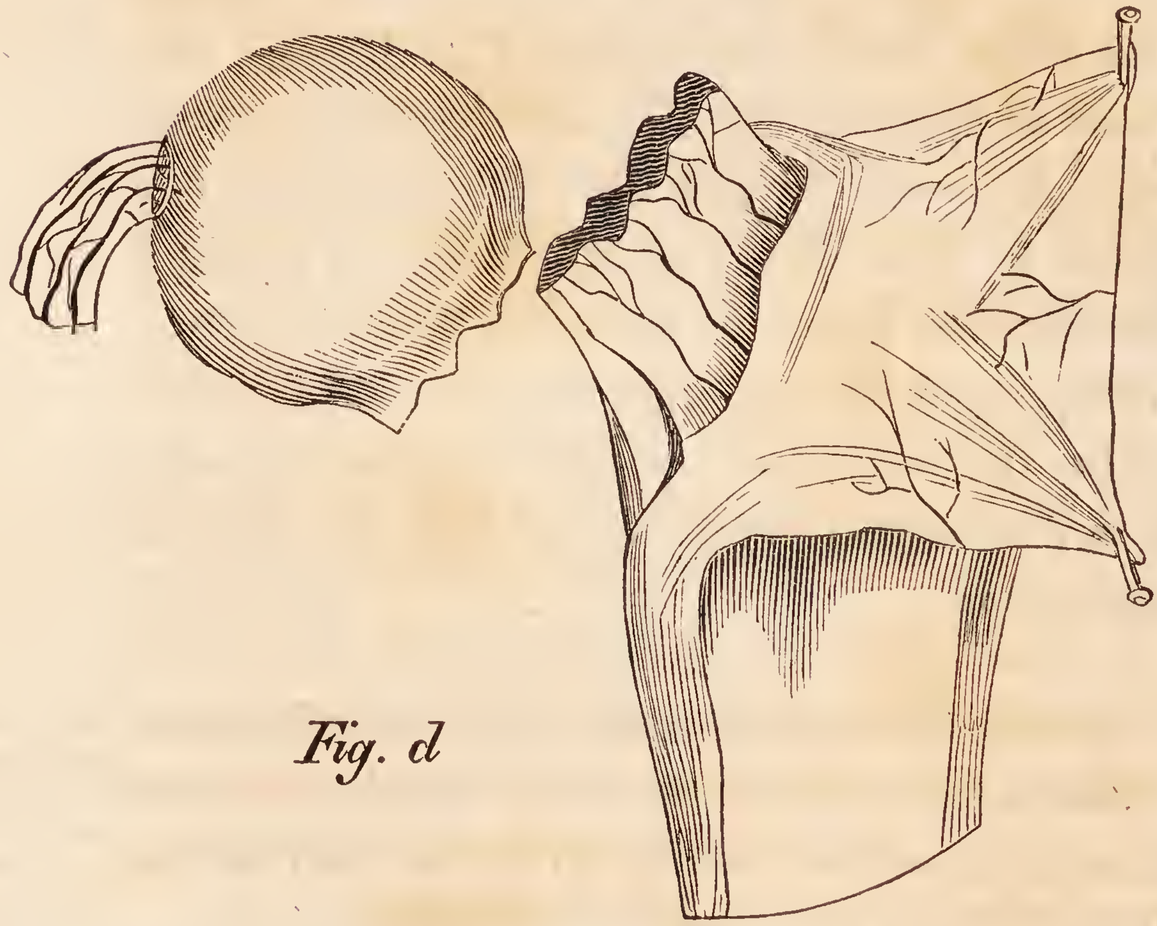

Fig. d

In fractures of this description, it is obvious, that the head of the bone is insulated from the shaft; and can only be nourished, while thus circumstanced, by the vessels which pass into it through the ligamentum teres. We should hardly suppose, *à priori*, that these vessels are sufficient to support the vitality of the head of the bone. Experience, however, proves that they are sufficient for this purpose, since I have never heard of more than one instance, and I am not aware of any on record, in which the head of the bone sloughed, in consequence of a simple fracture of the neck.*

The principal cause of non-union in Sir Astley Cooper's opinion.

We have here abundant evidence that the head of the bone receives a sufficient quantity of nourishment for its support; and the next point to be considered is, whether it receives enough for the production of an osseous union. If I properly understand Sir Astley Cooper, he believes it almost, if not quite, physically impossible, that bony union should be brought about in these cases; and his principal reason for this opinion is drawn from the manner in which the pelvic portion is nourished, when there is a fracture of the neck in this situation, accompanied with extensive laceration of the close coverings of the bone. He says, "the principal reason which may be assigned for the want of union of this fracture, is the absence of ossific action in the head of the thigh-bone, when separated from its cervix, its life being then solely supported by the ligamentum teres, which has only a few minute vessels ramifying through it to the head of the bone."

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* This was mentioned to me by Mr. Brodie. It occurred in a person whom he had an opportunity of examining after death.

The vitality of the head of the bone supported and a deposition of osseous matter produced.

The vessels, however, which enter the head of the bone in such cases, are not only sufficient to support its vitality, but are also adequate to the production of an osseous deposite; as is evinced by the state of the fractured surface of the pelvic portion, in many of these cases, a considerable period after the occurrence of the fracture.

Sir Astley Cooper's observations upon this subject.

Sir Astley Cooper, indeed, disputes this; but, in the very next paragraph, he says, "the cancelli are rendered firm and smooth by friction, as we see in other bones where their articular cartilages are absorbed, giving the surface the appearance of ivory."*

Observations upon Sir Astley's statements.

If this passage be strictly examined, I think it will appear that Sir Astley here admits all that is necessary for my present purpose, viz. that an osseous deposition does take place in the cancellous structure of the pelvic portion; otherwise we must infer, that friction alone is capable of increasing the density of bodies, so as to make those which are loose and cellular, like the neck of the thigh-bone, firmer than their natural structure. This, however, I believe, is not the case. I think it will be found that friction is as little capable of rendering the cancellated structure of the neck of the thigh-bone "firm and smooth," so as to "give it the appearance of ivory"; as it is of increasing the natural density of any other body whose parts are equally cellular and loosely connected. This appearance of the fractured surface can only

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* In the fourth edition of his work on Dislocations, Sir

Astley states, that "there are upon the head of the bone very small white spots like ivovy;" and, in the same edition, he says, "the fractured surface" of the pelvic portion "is sometimes partially coated with a ligamento-cartilaginous deposite." I give Sir Astley's expressions in the 1st and 4th editions of his work, because the ideas conveyed in both, upon this point, appear to me to be correct, though they differ a little from one another; for, in some cases, a great part of the fractured surface of the head of the bone has "the appearance of ivory," and in others, only "small white spots like ivory" are seen, and in some the surface is merely covered with a "ligamentous or a ligamento-cartilaginous deposite."

arise from a deposition of bone; which Sir Astley does not deny, by saying, that it is produced by the same cause as that which gives rise to it " in other bones," " when their articular cartilages are absorbed." I presume that few scientific surgeons will be disposed to dispute, that the dense structure which we see covering portions of the articular ends of a bone, in such cases, arises from an osseous deposition in the cancellated structure, and upon the surface of the denuded parts, from the arteries by which the bone is nourished; and, if this be the case, why should we assign the production of a similar appearance of the fractured surface of the pelvic portion of the cervix femoris to the operation of a cause which is incapable of producing it, when we see that it is effected in other situations by a natural process?

The vessels which enter the head of the bone might produce the appearance of ivory.

Independent of this fact, I see no sufficient reason to induce me to believe, that the same process which is accomplished on the articular surfaces, might not go on in the head of the thigh-bone when separated from the cervix, and only connected to the acetabulum by the intervention of the ligamentum teres, by an increased effort on the part of similar agents; though it is probable that this " appearance of ivory" will be more slowly brought about, in consequence of the vessels of the head of the bone being less numerous than those which supply the articular ends of the bone, where no fracture exists.

Further observations in favour of the possibility of bony union.

Let us pursue the arguments in favour of the physical possibility of union a little further. We see that splinters of bone which are insulated, will accept of union in the same way as other parts, provided they are not deprived of their vitality; and why should we deny this power to the head of the thigh-bone, which not only receives an adequate supply of blood for its support, but also for the production of an osseous deposition. Splinters of bone entirely detached, can only be passive in the process of bony union; and, consequently, are placed under circumstances much less favourable than the head of the thigh-bone, which it will be seen is able to assist in its accomplishment.

Other causes of non-union.

Sir Astley Cooper mentions two other causes, which also tend, though, in his opinion, in a *minor* degree, to prevent the consolidation of the fractured ends by the interposition of callus; namely, " want of proper apposition and the absence of continued pressure;" to which he might have added a fourth cause, want of rest; but all these impediments are purely mechanical; and consequently do not influence the question respecting the physical possibility of bony union, but are referable to the treatment, the inadequacy of which I shall hereafter attempt to demonstrate.

Sir Astley Cooper's statements, and the important fact derived from his investigations.

Sir Astley has shown that, these cases do not commonly unite by bone, indeed, so seldom does this take place, that he states, he has not yet seen a specimen sufficient to convince him that union by bone has ever been effected; but if a single case of bony union can be produced, the possibility of its occurrence, which is all I here contend for, will be, of course, at once established; and then we must consider, that the common results are principally to be attributed to the operation of causes, which are independent of the vital state of the fractured ends of the bone. It will then appear, that our eminent countryman has amassed evidence demonstrative of a most important fact, *viz.* that the usual modes of managing these cases are bad, and to their inadequacy we must principally refer the results which are usually observed. It will be seen that he has proved a general law, that these fractures do not commonly unite under any of the ordinary plans of treatment; the whole of the cases he has brought forward, will serve to show this fact; but, it is not to be inferred from these cases, that these fractures cannot be united by bone under any treatment; nor should we do so, were he to add a thousand to the number; unless it were at the same time proved, that the mechanical impediments to union were effectually got over by the treatment adopted.

Specimens of bony union.

Though Sir Astley has not, I believe, yet seen a specimen sufficient to convince *him*, that this variety of fracture has ever united by bone, there are now four preparations which satisfy the minds of many other surgeons, that osseous union is occasionally produced. Different modes of treatment were resorted to in the management of the patients, from whom these preparations were taken, some of which, however, it might be easily shown, were very imperfect; but, notwithstanding this, the fractures were found united after death.

The case described by Mr. Langstaff.

The first case I shall mention, was a patient of Mr. Cribbs, Holborn, the history of which is given as follows, by Mr. Langstaff, who has the preparation.

The woman " was about 50 years of age when the accident occurred. The foot was everted, and there was shortening of the limb at this time, and, after death, it was shorter than the other full two inches and a half. She was confined to bed nearly twelve months; during the remainder of her life, which was ten years, she walked with crutches."

" This" says Mr. Langstaff, (alluding to the bone in question, *see Plate* 1) " is a specimen of fracture of the neck of the thigh-bone within the capsular ligament; the principal part of the neck is absorbed; the head and remaining portion of the neck were united principally by bone, and partly by a cartilaginous substance. The capsular ligament was immensely thickened and embraced the joint very closely. The cartilaginous covering of the head of the bone and acetabulum had suffered partial absorption; the internal surface of the capsular ligament was coated with lymph.

" On making a section of the bone, it was evident that there had been a fracture of the neck, within the capsular ligament, and that union had taken place by osseous and cartilaginous media. With a view of ascertaining whether there was real osseous union, the bone was boiled many hours which discoloured it; but, by destroying all the animal matter, it satisfactorily proved the extent and firmness of the osseous connexion, and the vacant spaces which had been occupied with cartilaginous matter; these appearances are well exhibited in two drawings made shortly after the boiling."*

The particulars of Dr. Brulatour's case will also be found in the same volume of the Medico-Chirurgical Transactions, stated as follows:—

Dr. Brulatour's case.

"Dr. James, an English physician, forty-seven years of age, in good health, was thrown from his horse on the 20th of March, 1826. He fell directly upon the right great trochanter, but got up and walked a step or two, which occasioned such acute pain in the hip-joint, that he instantly fell again."

On examination immediately after the accident, Dr. Brulatour observed the principal signs of fracture of the neck of the femur, such as shortening of the affected limb; turning outwards of the foot; and a feeling of crepitation in the joint, when counter-extension was made.

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* Medico-Chirurgical Transactions, Vol. XIII.

“During the treatment of the case, the patient was confined to his bed for two months, and for the whole of that period, counter-extension was constantly kept up, so as to preserve the limb of its natural length.

“On the 20th of May, the splints and bandages were all taken off, and on the 30th, the patient got up, and with the assistance of crutches, walked a little in the room. On the 20th of June the crutches were put aside, and he walked with only the assistance of a cane. In August he was able to walk without any assistance, and subsequently recovered the full use of the limb.”

Appearances after death.

Dr. James died on the 22d of December, and upon inspecting the injured parts, the following appearances presented themselves. “1. The capsule a little thickened. 2. The cotyloid cavity sound. 3. The inter articular ligament in a natural state. 4. The neck of the femur shortened; from the bottom of the head to the top of the great trochanter was only four lines, and from the same point to the top of the small trochanter six lines. 5. An unequal line surrounded the neck, denoting the direction of the fracture. 6. At the bottom of the head of the femur, and at the external and posterior part, considerable bony deposite had taken place. A section of the bone was made in a line drawn from the centre of the head of the femur to the bottom of the great trochanter, so as perfectly to expose the callus. The line of bone indicated by the callus was smooth and polished as ivory. The line of callus denoted, also, that the bottom of the head of the femur had been broken at its superior and posterior parts."

Mr. Chorley, of Leeds, kindly sent to me the following case, which was read, by his desire, at the London Medical Society.

Mr. Chorley's case.

Mr. K. aged 72, in descending four steps from a neighbour's door, came suddenly on the pavement, and fell against the curb-stone, and was instantly so much hurt as to be unable to move from the place.

Upon examination, the limb was found shortened; the right knee and foot were turned outward; and the whole limb appeared loose, as if it had lost its support from the upper joint.

The patient was carefully removed to his room, and placed on the sound side. Pillows being placed between the limbs, so as to support the leg and thigh, gentle extension was made, by means of a circular bandage confined to the limb immediately above the knee-joint, to which was attached a weight, so that it might act in a line parallel with the hip-joint. Soap plaster, a bandage, and splints, were applied to press the fractured surfaces together. The patient was kept in bed three weeks in this position, when, from excoriation, it became necessary to alter it. He was then placed upon his back, with the limb resting upon a double-inclined plane. The dressings were occasionally tightened; and, at the end of six weeks, the inclined plane was removed, and the limb was laid in the straight position on a bolster. Soon after this, he was carried daily to another room, and laid on a sofa; in a little while, passive motion was allowed, the patient swinging the limb as he supported himself on crutches. This patient gradually regained the power of locomotion; and, at the expiration of seven months, walked so well that the "sceptical" thought that no such injury had taken place.

Appearances after death.

This gentleman died, twelve months after the accident, from inflammation of the lungs, and on examining the hip, it was observed that the synovial covering was united with the shortened neck of the bone, nearly at the head. Here Nature had also thrown out *broad ligamentous bands,* one on each side of the joint. These were firmly united to the head of the bone, and their breadth and extent may be distinctly traced on the head of the bone, *(see Plate* II. *Fig.* 1,) by the brown appearances there observable. The subject of this accident was healthy.

The upper third of the femur was taken out; and, when the soft parts were removed, the head of the bone was seen depressed in a line with the shaft. The fracture was slightly oblique, commencing at the upper part, close against the cartilaginous covering of the head of the bone, and extending downward and outward, so as to terminate in a point at the lower surface of the neck, one inch from the cartilaginous covering of the head. The posterior surface of the shell of the neck had the appearance of having been splintered, so as to make a part of the fractured end of the pelvic portion extend in one situation, a little external to the capsular ligament; but it is worthy of remark, that that portion of the fractured end which might, by some surgeons, be considered to have extended external to the capsule, *was not united.*

On making a longitudinal section of the head and neck of the bone, *(Fig. 2,)* the line of fracture was distinctly marked by the callus which now united the opposing surfaces. The pelvic portion had been excavated, and had received the lower portion of the shell of the shortened neck near the middle of its fractured surface, where it was firmly united by an osseous deposite.

The following case I had an opportunity of witnessing, during the life of the patient, through the kindness of Mr. Field.

Mr. Field's case.

A woman, æt. 63, healthy, and with both limbs of an equal length, was pushed down, as she was walking in the street, on the 21st of October, 1825, and fell upon the left side. She was taken up unable to bear upon the limb, and carried to St. Bartholomew's Hospital; where she was admitted, it is believed, with a fracture of the cervix femoris, and placed in a common bed, in the horizontal position; but no attempt was made to unite the bone. As soon as she was able to leave the bed, and walk with crutches, she was sent out of the hospital; as the surgeon under whose care she was, did not expect that any benefit would be obtained from the adoption of any of the usual modes of treatment. She now, five weeks after the accident, returned to the workhouse; in which she had lived for some time previous to its occurrence. After the lapse of several weeks, she was able to bear upon the limb, and could ultimately walk without support, having free motion in the joint; but, in consequence of the great retraction of the limb and eversion of the foot, she usually availed herself of the assistance of a stick, when in the act of progression.

On the 21st of December, 1827, she was again knocked down in the street, and now fell upon the *right* trochanter. She was carried to the workhouse, where I saw her with Mr. Field, three or four days after the accident; and, on examining the limb, we discovered a fracture of the neck of the right femur, with the limb retracted above an inch; which was ascertained by a peculiar mode of measurement. No attempt was made to unite the bone in this, any more than in the former instance. The woman lay in bed in the horizontal position, and died 19th of February, 1828.

I saw this patient only once before her death, but Mr. Field politely offered me the inspection of the body, which I did, in the presence of himself, Mr. Searle, and my senior pupil, Mr. Martin.

Appearances after death.

On cutting into the *right* hip-joint, a fracture of the neck of the femur was observed, with flakes of fibrin, coloured with the red particles of the blood, extending from one fractured extremity to the other. On opening the *left* capsule, it was thought that a similar injury had taken place in the neck of the left femur. The upper thirds of both thigh-bones were now taken out, connected with their acetabula ; in order that the particular state of the parts, on both sides, might be minutely examined.

Upon carefully inspecting the parts taken from the *right* side, *(see Plate* III. *Fig.* 1,*)* I found several large flakes of fibrin loosely adhering to the sides of the opposing ends of the bone, so as to form a weak bond of connexion between them. In one part, this adventitious connecting medium had become strong, but was still somewhat coloured with the red particles of the blood. The fracture extended through the neck of the bone, in a direction downward and outward, commencing at the upper part, where the head joins the neck, and terminating at the lower part in a point, about an inch from the cartilaginous covering of the head. In one part, a portion of the reflected membrane, about half an inch wide, remained entire; but was separated from the neck of the bone in such a manner, as not to prevent retraction of the limb. The head of the bone was somewhat excavated; and that portion of the neck attached to the trochanter, was partially absorbed; especially where it was brought into contact with the internal surface of the upper part of the capsule. There was no soft substance between the fractured surfaces. When the two portions of the bone were placed together, it was observed, that the cervix assumed its natural oblique line with respect to the shaft; but, in consequence of the absorption which had taken place, the fractured surfaces could not be brought together at every point.

The neck of the left thigh-bone *(Figs.* 2, 3, 4*)* appeared to have been fractured within the capsule, but was now firmly united. The cervix was nearly absorbed; and the head was depressed, so as to come within about two lines of the trochanter minor, to which it was united at its base by a small short crutch of bone. Strong broad bands of ligament *(Fig. 3)* were seen connecting the pelvic portion of the bone to the capsule, which had become thickened and much smaller than natural. There had been a very oblique fracture of the trochanter major, but it was evident that this was quite independent of the fracture of the neck of the bone. The fracture of the trochanter was united without displacement, from which it might be inferred, that there was but little laceration of the contiguous textures; but the fracture of the cervix was united with the head, about two inches and a half below its natural situation; which renders it probable that the close coverings of the neck of the bone were nearly or quite divided at the time of the accident, or subsequently to its occurrence. The anterior part of the neck of the bone *(Fig. 2)* was rendered smooth by the action of the tendon of the psoas magnus and iliacus internus. A portion of the anterior part of the base of the neck had also the appearance of having been fractured, and was pushed backward by the mechanical action of this tendon upon it.

A longitudinal section of the head and neck of the bone, *(Fig.* 4) showed, that the fracture had taken place close up against the head. The head of the bone, as in Mr. Chorley's case, was excavated, and received the lower portion of the shell of the neck, which was firmly united to it, near the middle of the fractured surface. The shell of the neck of the bone, which was united to the cancellated structure of the head, maintained its natural appearance and direction. The upper part of that portion of the neck attached to the trochanter, also preserved its natural oblique line with respect to the shaft; and, when the distance between the shell of the upper and lower portion of the neck was measured, it was found to give the natural thickness of the neck of the bone; which was ascertained by comparing it with the thickness of the cervix of the other femur at the same part. The callus, which united the opposing surfaces, had become cancellated in every part; but the direction of the fracture could be seen by the situation of the shell of the trochanteral portion of the neck, when examined in different parts of its circumference.

Observations upon these cases.

In looking at Mr. Chorley's preparation, some might be inclined to doubt, whether the fracture was entirely within the capsule. I believe, however, that the splinter of the shell of the neck, which *is not united*, and which now occupies a space, in which it is probable, that a very small portion of it was external to the capsule at the time of the patient's death, was altogether within the capsule at the time of the accident; but the head of the bone having approached nearer the trochanters than natural during the treatment, this splinter, also became displaced outward, and was ultimately made to assume its present unnatural situation. But in the other preparations which I have mentioned, showing bony union, I am humbly of opinion, and, in this opinion I am supported by several eminent anatomists and surgeons, who are not prejudiced in favour of any opinion upon this subject, that the breach of continuity took place entirely within the joint.

Opinions different from those which the author entertains respecting these specimens supposed—answered.

Some gentlemen might argue, that the appearances which these preparations present, might be produced by disease.* I have not, however, seen any specimen which would incline me to favour such an opinion; and I would enquire, if disease was ever known to produce, suddenly, in a person, in every respect previously healthy, the symptoms of fracture of the cervix femoris?

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* It would seem, that some surgeons are determined not to admit, even the possible occurrence of osseous union in these cases. In a conversation with an eminent surgeon who was a stanch supporter of the doctrine of non-union, I

Others will admit, that the bones were fractured in these specimens; that the fractures were within the joint; and that the fractured ends are now united by bone; but will not allow, that the fractures were attended with a division of the close coverings of the bone.

said, suppose you were requested to see an old person who had met with an accident, such as we find commonly produces fracture of the neck of the thigh-bone, and upon very carefully examining the injured limb, you should observe retraction to the extent of an inch or more, with eversion of the foot and *all* the other signs, which are described by Sir Astley Cooper, as accompanying fracture within the capsule of the hip-joint; and that this patient, after a reasonable confinement, in a position calculated to keep the fractured parts properly applied to each other and at rest, should recover the free use and natural power of the limb, without shortening or any deformity; and that, after death, the femur should exhibit very strong signs of having been fractured within the capsular ligament and re-united by bone, what would you say had been the nature of the accident? "Why," said he, "I should say, *that the neck of the bone had never been fractured!*"

Whether these coverings were completely torn through or not, it is impossible to determine, at this period; nor is it probable that this circumstance will be proved by any specimen which might hereafter be brought forward; for, in some cases, retraction, to the extent of an inch or an inch and a half, might take place, without a complete division of the periosteum and reflected membrane. It seems to me, however, that this degree of retraction could not occur without considerable laceration of these coverings, and consequent displacement of the fractured portions of the bone. Now, considerable shortening took place at an early period, in all the cases from which these specimens of bony union were taken, and consequently, it might be fairly inferred, that the fractures were accompanied with great laceration, if not complete division of the periosteum and reflected membrane; and I think it will be found very difficult, if not impossible, to arrive at any conclusion, which would come nearer to positive proof, as to the extent of injury which might have been inflicted upon these coverings, in any future specimen of bony union, in this situation, that might be submitted to the inspection of the profession. If, in any case of fracture of the neck of the thigh-bone within the capsule, there should be retraction to the extent of an inch, or an inch and a half, as the immediate consequence of the fracture, and union by bone should be afterwards brought about without shortening of the limb, or any other deformity, it might always be said, "it cannot be proved that the fracture was attended with a complete division of these coverings," for they would now be found entire. Hence, it will be seen, that we are not likely to obtain any better evidence upon this subject, for many years, than that which we at present possess.

The opinion, that bony union cannot be effected not justifiable.

If, in the course of time, it should be shown that, under the employment of means which are found sufficient to prevent the operation of those causes to which might be attributed, in a great measure, as I shall attempt to prove, the frequent occurrence of non-union, union by bone does not take place, where the periosteum and reflected membrane are divided, we might then say, that when the fracture is so circumstanced, osseous union cannot be effected; but till then, I am of opinion, with due deference to Sir Astley Cooper and others, that we have no right to come to any such conclusion, even in these, which must be regarded as the worst, cases that occur in the neck of the femur.

It is probable that favourable results might generally be obtained with good treatment.

But, if the treatment be good, I am inclined to believe, a sufficient number of facts to prove that union cannot *generally* be produced in these cases, when properly managed, will never be obtained. I have been led to this opinion by the consideration that, though the periosteum and reflected membrane be completely divided, and the head of the bone consequently deprived of the principal part of the nourishment naturally sent to it; a vascular communication is again speedily re-established by the production of organized matter, which, after a time, has the resemblance of ligament. This ligamentous substance is often found extending, in broad bands, from the head of the bone, to that portion of the neck which is attached to the trochanters or to the capsular ligament, with which it becomes firmly united. This soft substance also frequently exists between the fractured surfaces, filling up, in a great measure, the breach of bony continuity; and thus, at the same time that it prevents their further separation, it assists in conveying nourishment to the pelvic portion. Where this soft union has taken place, it is probable that the head of the bone is nearly, perhaps quite as well nourished, as when a fracture exists without laceration of the periosteum and reflected membrane, before any other vascular connexion is established between the fractured surfaces, than that which is given by these coverings. And, therefore, if this be granted, as far as regards the supply of blood to the pelvic portion, fractures with laceration, very soon become placed under circumstances nearly as favourable for the production of callus, as where the close coverings are not much torn—a fact, which it appears, has been altogether overlooked by the supporters of the doctrine of non-union; and one which strongly militates against the opinion, that want of nourishment in the head of the bone, is the *principal* cause of these fractures having, hitherto, been so seldom found united.

Objections to this opinion.

It might be said, that if ligamentous matter be formed between the fractured surfaces, it will prevent the process of ossification. To this I would answer, that its presence is not more likely to impede the process of bony union in fractures of the cervix, than in those which are situated in the middle of the bone; where it commonly exits in a tender state, at an early period after the occurrence of the accident, between and around the fractured ends.

Answered.

When the fracture is recent, and situated in the middle of the bone, this adventitious connecting medium is soon organized, but easily torn; and appears to be little more than recently organized fibrin, consisting principally of the remains of the clots of blood, with a plentiful supply of vessels shooting into it from the surfaces of the bone, and from the periosteum and medullary membrane. This medium assists in fixing the fractured ends of the bone, in these cases; in forming a vascular communication between them; and is, at the same time, the substance in which the callus is, in a great measure, ultimately formed. From this, it might be inferred, that the interposition of this substance, in the recent state, between the opposing surfaces of the bone, when the fracture is in the cervix femoris, is not likely to prevent or impede the process of bony union; but, on the contrary, to assist in no small degree, in closing the breach of continuity, by conveying nourishment to the pelvic portion; from which, and that which it derives through the vessels of the ligamentum teres, this portion is enabled to form an osseous deposition.

If the fractured ends are not prevented from moving upon each other, union by bone is not, on some occasions, effected when the fracture is in the middle of the femur. In these cases, however, ligamentous, or ligamento-cartilaginous union is, as far as I can find, always produced, when there is not any other substance, as muscle, &c. placed between the ends of the bone, so as to keep them separated from each other; and I have abundant evidence to shew that, under proper management, this ligamentous matter is absorbed, or converted into a state capable of receiving callus; and, though many months may have elapsed from the time of the accident, bony union is readily accomplished. If, then, in the other parts of the bone, the ligamentous connecting medium does not, when it has become firm and tough, prevent the ossific process from being completed, can any reason be assigned why it should do so, in every instance, when the fracture is in the neck of the bone where the same powers might be made to operate, though, perhaps, not in so great a degree, to effect its alteration or removal; I think not; and, if I am right in this opinion, it seems to me we ought not, in the present state of our knowledge, to abandon these cases, without first trying to produce bony union, even though they should have existed several months.

Union should be effected

The treatment, however, is bad, which does when the fracture is in the recent state.

not bring about union by bone, in the recent state of the injury, where the fracture is at a distance from any joint; when the system and the bone are healthy, and there is nothing existing between the fractured ends but the soft substance to which I have alluded; and, I think, we shall be obliged, ere long, to come to the same conclusion with respect to fractures of the cervix femoris within the capsule; as the soft medium formed between the opposite surfaces, does not, in my opinion, render these fractures essentially different from fractures which occur in other parts of the bone.

Inference.

The view, then, which I take of this subject, has led me to infer, that the physical condition of the fractured ends, upon which Sir Astley Cooper founds his principal argument in favour of the opinion which he entertains, is not in itself sufficient to account for the, hitherto, almost constant occurrence of non-union, when the fracture is within the capsule of the hip-joint.

Having attempted to shew, by cases and arguments, that there is no apparent physical cause sufficient of itself, to prevent the process of osseous union in fracture of the cervix femoris within the capsule, I shall now consider, how far its accomplishment might be deemed advisable.

How far may it be deemed advisable to produce osseous union in these cases?

When the powers of the limb and the walk of the persons who have had fractures of the neck of the thigh-bone united by ligament, are observed, and compared with the powers of the limb and the facility of progression which are seen in those who have had union effected by the interposition of callus; doubts may arise in the minds of some surgeons, as to the propriety of attempting to produce bony union, in any case where the fracture is evidently within the capsule. We see, in some cases, in the former class, that the sufferers are able to walk, in the course of time, without any adventitious assistance, having that variety of lameness which is called a drop, when the weight of the body is thrown upon the injured limb; but even this degree of power is not obtained for a long period after the accident. In other instances, the functions of the limb are so much impaired, in consequence of the injury sustained in the neck of the bone and surrounding parts, that the patients are never after able to walk without support. These persons experience great difficulty in the act of progression, and are commonly seen hobbling about with the assistance of crutches. So we have seen, that the persons in whom bony union had been produced a considerable period before their death, were also able to walk with different degrees of facility. Dr. James, whose case Dr. Brulatour has related, acquired the full use of his limb for a considerable time previous to his dissolution; which occurred about ten months after the accident. The gentleman from whom Mr. Chorley obtained, his specimen had also free motion in the joint, and was able to walk with a slight limp, soon after the bone was united. In these two cases, however, we see little more advantage obtained, than what we observe in some very rare instances, where the fractured surfaces are connected by short ligament. In the other two which I have related, less benefit was observed. In Mr. Langstaff's case, the patient could not walk without the assistance of crutches, from the occurrence of the accident to the period of her death; which took place ten years afterwards. The woman, from whom my preparation, showing bony union, was taken, was able to move the limb with facility, notwithstanding the head of the bone was depressed, and so close to the shaft, as actually to rest, by the intervention of a very short crutch, upon the trochanter minor; but, in consequence of the retraction of the limb, which had taken place, she was unable to walk without great lameness, and never attempted to go far, without availing herself of the support of a stick. Thus, it might be seen that, the four cases of bony union above detailed, prove very little more than the physical possibility of union by osseous matter. The evidence which they offer in favour of the superiority of bony union over ligamentous, is so small, that it can hardly be considered sufficient to induce us to recommend our patients to undergo that degree of confinement, which might be necessary for its accomplishment.

Can no better results than those detailed be obtained?

But must we infer, from these cases, that no better results can be obtained? I think, when we enter into this subject a little further, we shall perceive that we have no right to come to this conclusion. What constitutes the imperfection in these cases? Evidently the deformity of the limb, which is partly occasioned by the absorption of the neck of the bone. Absorption of a great part of the neck of the bone is found to have taken place in all those cases of fracture where the patient survived for a year or two after the accident; whether union had taken place by the intervention of ligament or callus.

Is shortening of the cervix to be considered a necessary consequence of fracture of this part?

Are we then to consider absorption of the cervix femoris, as a necessary consequence of fracture of this part? I presume not. I am strongly induced to believe, that shortening of the neck of the bone will be found to be the result of the irritation which is occasioned in the injured parts, by the frequent motion and unnatural pressure, which are allowed to take place in these cases; and which none of the usual modes of treatment is calculated to prevent. We find in other situations, that if the end, or a portion of a bone, projects in such a manner as to be a source of constant irritation, either to itself or to the surrounding soft parts, it is generally acted upon by the absorbents, till the irritating points are removed. This we observe in the sawn extremity of a bone left after amputation. We see the same thing frequently in fractures of the middle of a bone, when the fractured ends overlap, and sometimes even in the edge of the acetabulum *(see Plate* VII. *Fig.* 1,); and I cannot discover any reason sufficient to lead me to suppose, that the absorption of the neck of the thigh-bone takes place from any other cause than that which we find gives rise to absorption of bone in other situations; *viz.* the irritation which it occasions; and which is kept up for a long, but indefinite period, in consequence of the frequent motion of the fractured ends upon one another, and upon the surrounding soft parts, for want of proper treatment. Hence we might infer, that the degree of absorption of the neck of the thigh-bone, will generally be in proportion to the degree and continuance of the irritation produced in the substance of the bone, and in the joint, by the unnatural motion and pressure of the fractured ends; and as the trochanteral portion of the neck is capable of producing the greatest mischief, this portion always suffers most from the process of absorption.

The author's opinion upon this subject.

If, then, I am right in the opinion, that absorption of the cervix femoris is not a necessary result of a fracture of this part, but is commonly produced, in consequence of the irritation which is kept up in the fractured portions of the bone and in the joint, especially in and by that portion of the neck whose movements are most injurious, viz. that which is attached to the shaft, it will be seen that, if the fractured surfaces were brought together, and kept at rest, such irritation would not take place; and, therefore, that absorption of the neck might be prevented by any contrivance, capable of fixing the broken ends of the bone, so as to prevent them from moving upon each other. According to this view of the subject, we might conclude, that absorption of the neck of the bone is probably referable to the imperfection of the treatment usually resorted to as a remote cause; and not to any law of nature peculiar to this part.

What is the cause of absorption where an osseous union is effected?

It might, in opposition, be argued, that if absorption of the neck of the bone takes place, in consequence of the irritation which it is allowed to keep up, how does it happen that there is, in some instances, as much absorption where union is effected by bone, as, where the parts are only connected by the intervention of ligament? In answer to this, I should say, that there is no proof that osseous union did not take place in all the specimens yet obtained, notwithstanding the resistance offered by motion and displacement; and, as there is reason to suppose that motion of the fractured parts was not prevented during the treatment of the patients from whom the specimens were taken, any more than displacement, it might be inferred that, as the same causes were allowed to operate, they would be followed by the same consequences in these cases, as in those where union by bone has not been effected, till the parts became fixed upon one another, either by very short ligament, or by callus. Bony union might have taken place at different periods after the accident; and, in proportion to the duration of the interval between the occurrence of the accident, and the fixed condition of the fractured portions, we might expect would be, in most cases, the degree of absorption of the neck of the bone. We are not certain, however, what length of time elapsed in any of the four cases I have mentioned, before consolidation of the bone was completed; and, therefore, we cannot say how far the degree of absorption, which is observed in the different specimens, corresponds with the length of the periods in which relative motion of the opposing ends was allowed. I may or may not be right, in supposing that absorption of the cervix femoris is referable to the operation of the same causes, whether the fracture be united by a deposition of bone or ligament; but this is a point which future experience will probably decide. It also remains to be determined, whether absorption of the neck of the femur goes on after bony union is completed. We know it sometimes occasions the removal of nearly the whole of the neck of the bone, where no injury has been sustained; and I see no reason to think, that it might not, now and then, do so after the union of a fracture of this part. From this, it will appear, that we are unable to state whether the absorption of the neck, in the examples of bony union adduced, took place subsequently to the completion of the ossific process, or before the fractured ends were fixed. I am rather inclined, however, to the latter supposition.

Inference.

After having considered this subject with much attention, I have not been able to discover any argument, which would militate against the opinion that I am disposed to entertain; *viz.* that absorption of the neck of the femur, which occurs after fractures within the capsule, is not a necessary consequence of a fracture of this part; but is, in the specimens already examined, bony as well as ligamentous, probably, to be attributed to the imperfection of the treatment adopted, rather than to any law of nature peculiar to the cervix of the femur. The accuracy or inaccuracy of this opinion, however, can only be shown by specimens procured from persons who have been treated in such a manner as to insure a perfect state of quietude during the process of union; for, if we have ever so many cases in which union has been produced without shortening or other deformity, we cannot determine this point by them during the life of the patient; as we have still to learn the precise situation of the fracture, as well as the kind of union which had taken place; which can only be ascertained by a minute inspection of the parts after death.

Fractures of the cervix femoris should not be abandoned till proper means have been employed.

The absence of direct and convincing evidence upon this subject, it will be seen, is no argument against the propriety of attempting to unite any case of fracture of the neck of the femur; for such is the nature of these injuries, that, I believe, it is sometimes impossible to discover the exact situation and direction of the fracture; without subjecting the patient to such an examination as would be by no means warrantable. The strongest advocates for the opinion, that fractures of the cervix, within the capsule, will not unite by bone, when accompanied with laceration of the close coverings, readily admit that, if the fracture be external to the capsule, or partly within and partly without, osseous union might be produced; and the patient recover with a useful limb. Unless, therefore, it can be shown that these three accidents can be readily distinguished, in every instance, from one another, it is evident, from these gentlemen's own statements, that no fracture of the cervix should ever be abandoned till proper means have been employed, for a reasonable length of time, with a view to produce consolidation of the bone.

It is probable that bony union might be frequently produced.

It might be doubted, by some, whether union by bone, in a fracture of the cervix femoris, can take place, when frequent motion of the fractured parts is allowed. This, however, is nothing more than what we see in fractures situated in the middle of the bone. If the fractured ends did not commonly coalesce by the intervention of callus, in spite of this impediment, I believe, we should not, with the ordinary means, be able to produce union in one case out of fifty, even when the fracture is in the middle of a bone; but, as the parts are less perfectly nourished and supported by the surrounding textures when the fracture is in the neck of the femur, than when in the shaft, I conceive the influence of motion will be in the same proportion more injurious; and this appears to me to be the principal reason why we have hitherto so rarely met with union in fractures of the cervix femoris when situated within the capsule. The fact that non-union occasionally occurs in the middle of a bone, as the result of motion of the fractured ends, is sufficient to show that the operation of the same cause alone might prevent union; and, under the peculiar circumstances of the parts, would be likely to do so, in most instances, when the fracture is in the neck of the femur; and the fact, which is abundantly obvious to my mind, of bony union having taken place in the neck, when the fracture was within the capsule, in opposition to the unfavourable nature of the treatment, tends strongly to prove, that if the fractured surfaces were kept in apposition and at rest, such union would be frequently obtained.

Causes of non-union in these cases, with observations.

From what I have myself observed, and from what I have been able to collect from the observations of others, I am led to believe, that the causes of non-union, in fractures of the description above-mentioned, are four: 1st. A diminution in the quantity of blood sent to the pelvic portion of the bone; 2d, absence of continued pressure; 3d, want of apposition; and, 4th, want of rest. The first of these is inseparable from the nature of these cases, but, in my opinion, is to be regarded as the *least important*; for, though this will have an influence in retarding the uniting process, as I have above stated, I believe that there is now sufficient proof to lead to the conclusion, that it is not in itself sufficient to prevent osseous union from being accomplished. The other three causes are referable to the treatment; and, if it can be shown that we are in possession of mechanical means, by the judicious employment of which, apposition, pressure, and rest, might be maintained for any length of time, these three causes, it is evident, will be at once removed; and, as union by bone now and then takes place, notwithstanding the operation of these three causes, we might, it seems to me, reasonably expect, that it will be very generally produced, where the treatment is such as to prevent their occurrence.

Unfavourable results might sometimes occur under the best treatment.

I do not wish it to be inferred, that we shall not sometimes meet with cases of non-union in the neck of the bone, even where the best means have been employed; but such instances, I think it will be found, will occur principally where the system is *extremely* weak, as we now and then see it in very old persons; or where the patient is unmanageable, and will not steadily adhere to our directions; where there is some disease of the constitution; or disease of the bone, or of the soft parts by which it is surrounded. These causes, however, would operate against the production of osseous union in any other part of the bone as well as in the cervix.

Ought these cases to be left to Nature?

Before I could become an advocate for the practice of abandoning fractures of the cervix within the capsule, surgeons, who support it, must prove satisfactorily that the patient can derive no advantage from mechanical means; they must also show that there are unequivocal symptoms by which a fracture of this part of the bone might be distinguished, in every instance, from one external to the joint. If there be any such signs I have not been able to ascertain them. I know of none which are not occasionally fallacious, nor do I believe that any such exist; or, at best, any sufficiently marked, to be, in every instance, palpable to the senses even of the most scientific and experienced surgeons. If this be the case—if surgeons, who support the doctrine of non-union, cannot point out some well-marked and infallible sign or signs which invariably accompany fractures within the joint, and are not observed in those external to it, or in those which are partly within and partly external, their practice must be sometimes at variance with their principles—they must occasionally abandon cases which, from their own showing, admit of cure; and confine patients for whom, according to their reasoning, nothing beneficial can be done. Suppose, however, it were granted that fractures within the capsule can at all times be distinguished from all other fractures which occur in the neck of the bone; and that, when the fracture is within the joint, bony union cannot be produced under the most judicious employment of the best mechanical contrivances, is there any good reason why these accidents should be abandoned as entirely irremediable? If there be any, I confess I cannot see it.

Ligamentous union.

For the last eight years, I have been accustomed to say in my lectures, and elsewhere, that the practice of leaving patients to their fate, who are supposed to have fractures of the neck of the thigh-bone within the capsule, is, in my opinion, bad. If these fractures could not be united by osseous matter, is there any reason why the apposing ends should not be connected by a layer of short ligament, extending from one fractured surface to the other? When I had not evidence sufficient to convince me of the possibility of bony union being effected, I always endeavoured to inculcate, that a mode of treatment which would give the fractured surfaces a fair chance of coalescing, would be almost sure to benefit the patient; for, if bony union were not produced, union by short ligament would, in the worst cases, in all probability, be accomplished; and the patient so injured, would thus be enabled to get about with that degree of facility which we see in the most favourable results that have been obtained by any of the ordinary means. In corroboration of this opinion, I might state that, as far as I have been able to discover, those persons who have recovered sufficiently to walk with the assistance of a stick, and occasionally short distances without even this aid, have had union effected in this way, *(see Plate* IV. *Fig.* 1) or by a deposition of callus; but nothing has been said, that I know of, about the propriety of attempting to produce union of this fracture by short ligament, even by those gentlemen who contend that bony union never takes place. Hence, we find that the fractured surfaces are allowed to separate from one another, where the close coverings are divided, as far as the capsular ligament and the quadratus femoris will allow; and, though the fractured ends are connected by ligament in such cases, the ligament is commonly so long, that the limb is very little better than it would be were no connecting medium effused; for, when the weight of the body is thrown upon the limb, it must necessarily drop towards the ground, till the capsular ligament or the muscle I have mentioned is put upon the stretch; and, consequently, patients so circumstanced are rarely able to walk, during the remainder of their lives, without the assistance of crutches.

The advantages of short ligamentous union.

If, on the contrary, the fractured surfaces were kept in close apposition, and at rest, it is probable that, in cases where osseous union could not be effected, the fractured surfaces would be firmly held together by a layer of ligamentous matter interposed between them instead of callus; and if, in such cases, the patient were confined a sufficient length of time, this would acquire so much strength as to prevent the broken ends of the bone from separating in any considerable degree, even when the weight of the body is thrown upon the limb. Even supposing then, it should, in the course of time, be found that bony union cannot generally be effected, if we can produce union by short ligament, what shall we gain? We shall prevent that horrible lameness which is the result of the worst of these injuries. I do not say that any patient, in whom short ligamentous union has been produced, will be likely to have the use of the limb as perfect as before the accident; but, I am disposed to believe that, we shall so far restore it, as to enable him to walk with but little impediment. The facility of moving the limb will be proportionate to the shortness and density of the ligament, connecting the broken ends of the bone; and, as these qualities will render the ligament proportionably strong, it is to be expected that the power of the limb will be in the same degree restored.

The strength of the connecting ligament of great importance.

A great object in such cases would be, to have the ligament as strong as possible; and, for this purpose, it would be necessary to confine the patient nearly or quite as long as one might expect would be requisite in order to effect union by bone. The ligament which unites fractures of the patella is thin, and usually gives way a little when the patient bends the limb, even after a confinement of six or eight weeks; but this is more particularly the case if the patient is suffered to move the limb *too early*. The same thing occurs in fractures of the olecranon united by ligament; but in both these situations the ligament, though thin, is capable of resisting the ordinary action of the muscles.

From this we should infer, that the ligament, which would be effused between the broken ends of the bone when the fracture is in the neck of the femur, would be able to support the weight of the body, and much more, without yielding; for here we should find the ligament much larger than that which connects the two portions of a fractured patella; it would also be acted upon in that manner which would enable it to oppose the greatest resistance to the superincumbent weight. The ligament, in some instances is nearly equal in diameter to the neck of the thigh-bone, or rather to the surfaces between which it is placed; and, as the weight of the body has no tendency to cause the ends of the bone to separate in a line with the neck, but to make them pass each other in the transverse direction, the ligament is situated in the most favourable manner to resist the forces that tend to make it yield. Hence we might infer, that a bone thus united would be nearly as strong, though not so steady and manageable, as it would be if the bond of union were osseous. By treating patients, therefore, in such a manner as would favour union by bone, we should give them every advantage which it is in our power to offer; for, in the worst cases, we might expect that, should bony union not take place, short ligamentous would be obtained, and thus they would, at all events, be much benefited by the judicious employment of proper mechanical contrivances.

Inference.

From these considerations I conclude, that the practice of leaving fractures, which are supposed to be within the synovial capsule, to Nature, even presuming that they were easily ascertained and could not be united by bone, is one which, in the present state of our knowledge, is not scientific; and, therefore, ought not to be followed.

Sir Astley Cooper's reason for abandoning these accidents.

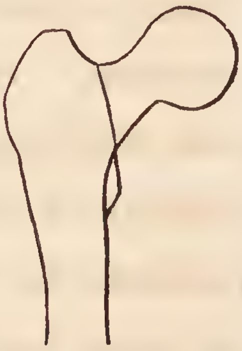
By this conclusion, however, I wish it to be understood, that I am far from casting any blame upon those who have given an opposite opinion. Sir Astley Cooper has said, that he was induced to abandon the usual modes of treatment followed in cases of this description, because he had not met with any which, in his opinion, had been beneficial. He was led to do this the more readily from the belief, that the principal cause of failure was referable to the particular condition of the injured parts; but as it is now shown that we have means, by which the evils, accompanying the use of the old mechanical contrivances, can be prevented, and that, whether the union effected be osseous or by the intervention of ligament, patients derive great advantage from the employment of the new, he will be perfectly justified in recommending their adoption.

SEC. 4.—*Fractures of the Neck of the Thigh-Bone external to the Capsule, without any considerable Laceration of the Periosteum.*

Of two kinds.

Fractures of the neck of the thigh-bone external to the capsule might, as I have said, be divided into two kinds, dependent upon the degree of injury sustained by the soft parts attached to this part of the bone.

The age at which these fractures occur, and their causes.



Fractures external to the capsule occur most commonly in persons under fifty years of age, but they not unfrequently happen in old persons. Fractures within the capsule which are met with in old people, often result from very slight causes; this may, also, happen in them, when the fracture is external to the capsule; but those which take place external to the capsule, in persons under fifty years of age, whose bones have not become weakened by absorption, are usually produced by great violence; such as violent falls upon the trochanter major; the passage of laden carriages over the pelvis; or other forces, as blows, &c. operating indirectly upon this part of the bone.

Symptoms.

When the fracture is not attended with laceration, the symptoms are so similar to those which are observed when the bone is broken within the capsule, without any considerable injury to the close coverings, that it will be found, in many cases, exceedingly difficult to distinguish them from one another. The best surgeons sometimes fail in their diagnosis as to the situation of the fracture; and I am not acquainted with any symptoms accompanying this accident which are, in every instance, sufficiently marked to enable the scientific surgeon to say that the fracture is external to the capsule. The symptoms of this injury are sometimes altogether very obscure. I have known it overlooked, and the patient considered to have laboured under the effects of a contusion of the soft parts in the vicinity of the joint. I was once present during the inspection of a man who died of disease of the heart, about two months after he received an injury at the upper part of the thigh, in whom there was found a fracture of this description, which was not discovered till after his decease; though the limb was several times examined by a very able surgeon in this town. The periosteum was torn only in a very slight degree; and, consequently, the fractured portions were held so close together, that the head and shaft of the bone moved simultaneously when the limb was rotated, therefore no crepitus was felt. There was a trifling difference in the length of the two limbs, and the foot was a little everted. The shortening which existed was produced by the alteration in the direction of the neck of the bone; which was slightly depressed, and driven a little way into the cancellated structure of the trochanter major. The tumefaction of the limb is usually greater than when the fracture is within the capsule; and there is sometimes ecchymosis. These are the only signs that I have noticed in this accident, differing from those which accompany similar injuries in the joint, and these will be found often fallacious.

Neck sometimes driven into the trochanter.

Sometimes the neck of the bone is broken off at its junction with the shaft, and driven, a considerable way, into the cancellated structure of the great trochanter; *(see Plate* IV. *Fig.* 2.) and remains firmly locked there for a considerable time. The symptoms of fracture of the neck of the bone thus situated, are not such as will enable us to decide, with certainty, in all cases, upon what part of the cervix is broken. More or less shortening of the limb, pain at the upper and inner part of the thigh and behind the trochanter, more or less tumefaction soon after the accident, great diminution of power in the limb, and absolute lameness, are the only symptoms which are likely to occur, till the neck of the bone is disengaged from the trochanter, so as to move independently of it; and then the crepitus of fracture might, also, commonly be felt when the limb is rotated or bent upon the pelvis.

Causes of this fracture.

It appears to me, that the only way in which these fractures can be produced, so as to drive the neck of the bone into the substance of the shaft, is by falls upon the trochanter major, or by some force which will operate in the same direction.

Persons with fracture of the neck of the femur sometimes able to walk without support.

I am disposed to think, that it is in these cases, or in those which are unattended with laceration of the contiguous texture, whether the fracture be within or external to the capsule, or where the fracture is incomplete, that patients are able to walk immediately after the accident with some assistance; such as the support of a stick or the arm of another person, or, even, in some instances, without any adventitious aid, as occurred in the following case.

Case.

Mrs. Shaftoe, one of the sisters of Guy's Hospital, æt. 62, fell off the curb-stone, as she was passing over London Bridge, on the 21st of December, 1822, and pitched upon the stones in the carriage-way. The force of the blow was principally received upon the outer and posterior part of the trochanter major. She was picked up by persons who saw the accident, and was able to walk, by holding a gentleman's arm, as far as the top of St. Thomas's Street in the Borough, (a distance of about three hundred yards,) but not without great pain and limping. From the top of St. Thomas's Street to the gates leading into Guy's Hospital (about one hundred yards) she walked *without assistance.* Here she found her limb give way, and she was unable to walk any further. She was carried from this into the hospital and placed in bed.

Mr. Key saw her immediately after she was brought into the house, and examined the limb, but did not discover the fracture. Sir Astley Cooper examined the limb, also, on the next day, and was of opinion that there was no fracture. The whole of the inconvenience she felt was at this time referred to the upper and inner part of the thigh, and the hollow behind the trochanter major. She could bend the limb upon the pelvis; and though, when left to itself, the limb became slightly everted, she was able to roll it inward, so as to bring it to what might be called its supine position. As these gentlemen did not discover that there was a fracture, we might suppose that the usual strong signs of fracture of the cervix femoris, *viz.* eversion of the foot, retraction of the limb, and crepitus, did not then exist, or, at least, were not strongly marked.

On the 7th of January, 1823, I examined the limb by her desire, and found that the bone was fractured through the neck; which I discovered by rolling the limb inward, and bending it upon the pelvis. In this way crepitus was now easily produced. Sir Astley Cooper saw the woman again the same day after me, felt the crepitus, and corroborated my opinion, as to the existence of a fracture in the cervix, but considered that it was external to the capsule.

She had been permitted to move about in bed, and to have her bed made at pleasure for seventeen days; which circumstances were sufficient to account for the alteration which had taken place in the condition of the fracture.

My notes do not state that any thing was done for this woman with a view to keep the parts quiet or in apposition, till the 17th of January—twenty-seven days from the date of the accident; but, if I recollect right, the limb was placed upon the common fracture-box for a few days after the fracture was discovered. This was removed, in consequence of the inconvenience which she experienced from it, and that which I invented for fractures, &c. of the lower extremities substituted. This apparatus, though not intended for fractures of the neck of the thigh-bone, promised more advantages in these cases than any contrivance that I had *then* seen employed.

Before the apparatus was applied, the limb was lying in the extended position, and retracted about an inch. The foot was everted. Crepitus could easily be produced. The limb could be brought down to its proper length with facility by extension, but it was again retracted as soon as the extending force was discontinued. The apparatus was worn, with the limb in the straight position, from the 17th January to the 12th of the following March. Its use was now discontinued, as I considered the fracture was united, though not without shortening of the limb.*

Neck of the bone sometimes received into a cavity.

Occasionally, the cancellated structure of the trochanter major becomes absorbed subsequently to the injury; and afterwards the neck of the bone is partly received into the excavation. There is a case mentioned in Sir Astley Cooper's work, in which this took place. The fracture was produced by a twist of the limb without falling.

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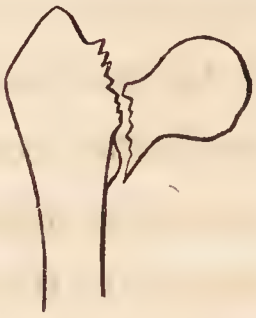
* This woman lived several years after the accident; and was able to walk about with facility, without a stick or any other assistance, though not without limping, in consequence of the shortened state of the limb. After her death, Sir Astley Cooper obtained the upper part of the thigh-bone; and he has stated to me in conversation, that the bone is consolidated, that the cervix is absorbed, and, that there is no appearance of callus. From the last observation, I infer, that the callus has become cancellated. I have not learned at what part of the cervix the fracture appeared, upon inspection, to have taken place.

Sec. 5.—*Fractures of the Cervix Femoris, external to the Capsule, with great laceration of the surrounding Parts.*

Symptoms of this accident.



The symptoms which accompany this variety of fracture, are much more strongly marked, than those which are observed when the fracture is not attended with any considerable laceration of the softer textures ; and, for the most part are very similar in some instances, to those which accompany fractures of the cervix within the capsule, attended with laceration of the close coverings. The eversion and retraction of the limb are very evident ; but the degree of shortening is usually proportionate to the degree of laceration ; in this variety of fracture, however, it is commonly from half an inch to an inch—seldom exceeding an inch. The cause of the retraction being greater in fractures of this description, which occur within the capsule, than in those which are external to it, will probably be found to depend upon the state of the parts which surround the bone in the two situations. Within the capsule the bone is surrounded only by the periosteum and reflected membrane; but, at the root of the neck, where fractures external to the capsule usually occur, the bone is surrounded and protected by the dense fibres of the capsular ligament, which is inserted into it at this part, and is very seldom entirely torn through. In addition to the symptoms which attend a fracture *within the capsule* accompanied with laceration of the close coverings, *viz.* eversion of the foot—retraction of the limb, &c. we have in this variety, generally considerable tumefaction of the surrounding parts, accompanied with ecchymosis. This very rarely occurs when the fracture is entirely within the synovial membrane. Pain produced by rotating the limb is common to fractures within, and to those which are external to the capsule; but it is much more severe when the fracture is external to, than when it is within the joint. The reason of this is evident. When the fracture is *external*, the broken ends of the bone prick and lacerate the muscles with which they come in contact, and which are exceedingly sensible when they are inflamed; but when the fracture is within the ligament, the broken ends of the bone rub against the synovial membrane, which possesses much less sensibility than the muscles. The difference in the degree of swelling, too, might be easily accounted for upon scientific principles. The force which produces fractures within the ligament is often trifling, when compared to that which usually occasions fractures external to it. The swelling which comes on in the first variety, is confined, for the most part, *within the cavity of the joint;* but in the second, the swelling is diffused. Sometimes the whole of the thigh is much enlarged, in consequence of extravasation of blood, and in consequence of inflammation, accompanied with an effusion of fibrin and serum. These fractures, as I have said, occur most frequently in persons below fifty years of age, but they are not uncommonly met with in persons very far advanced in years; though, from the peculiar alteration in the structure of the neck of the bone, which frequently obtains in very old people, and by which it is rendered weaker, especially near the head, the fracture of the cervix in them is usually within the joint. Crepitus, might almost always be felt with facility, when the fracture is external to the capsular ligament and loose; but, when it is entirely within, it cannot be elicited, sometimes, even by the most judicious surgeons.

Foot sometimes inverted.

Fractures, external to the capsule, are occasionally accompanied with inversion of the foot. In these cases the fracture of the cervix has been found complicated with fracture of the trochanter. Mr. Guthrie, in a paper published in volume xiii. of the Medico-Chirurgical Transactions, has detailed an instance, which tends to illustrate the causes which give rise to this position of the limb.

Case.

"Sarah Gibson, æt. 90, fell, on the 9th of January, from a high stool on which she was sitting, upon the left hip, and, being a heavy woman, suffered considerable injury. I saw her, two days afterwards, with Mr. Dillon of Judd Street, and found the marks of considerable contusion having been sustained by the part, which was very painful and swelled. The limb was rather more than half an inch shorter than the other, and the great toe turned inwards, in a manner sufficiently marked, although not quite so decidedly as in a case of dislocation. The limb was moveable in every direction, but these motions were attended with considerable pain, and it could be easily extended to the same length as the other. No crepitus could be distinguished. The patient died on the 22d of February, forty-four days after the accident, and, on dissection, a fracture was discovered external to the capsular ligament. The little trochanter was broken off, and with it the attachment of the psoas and iliacus muscles. The head and neck of the femur were separated from the shaft by a diagonal fracture, extending from the upper and outer part of the trochanter major to the trochanter minor, so as to leave the insertions of the pyriformis, gemellus, obturator externus and internus, and quadratus, with the head and neck of the bone. The gluteus medius formed a bond of union at the upper part of the trochanter major, between the broken pieces, retaining them in contact. The capsular ligament was not injured, and no steps whatever appeared to have been commenced to repair the mischief which had been committed."

Case.

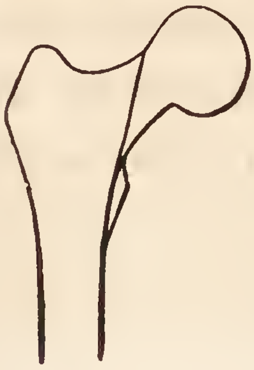
In the 25th volume of the Edinburgh Medical and Surgical Journal, Mr. Syme has related a case of fracture of the cervix, which was accompanied with inversion of the foot. In this case, which occurred in a man between 50 and 60 years of age, " the limb was shortened more than an inch, the knee being bent over the sound one, and the great toe resting on the instep of the other foot. The trochanter major was higher up and more forward than natural, and any movement excited excessive pain." The injury was occasioned by a fall upon the side. The man died a fortnight after the accident, "in consequence of inflammation in the lungs, and most extensive sloughing on the sacrum."

"On dissection, I found the capsular ligament entire, but two fractures beyond; one detaching the neck where beginning to spring from the shaft, the other running obliquely downward and inward through the trochanters, so as to detach the posterior part of the greater, and the whole of the lesser in one piece from the body of the bone."

The dissection of a case very similar to that which occurred to Mr. Syme, and which was also attended with inversion of the foot, is detailed by Mr. Stanley in Part ii. of Volume xiii. of the Medico-Chirurgical Transactions.

Fracture partly within, and partly external to the capsule.

Fractures of the cervix femoris are very often partly within and partly external to the capsule; but the symptoms which denote the existence of fractures of this description are usually so vague, that the surgeon will often be obliged to confess himself unable to determine, as to the precise si-



tuation and direction of the fracture. It is gratifying, however, to observe, that uncertainty in any case of fracture of the cervix need not influence the treatment, which it will be considered proper to adopt. But, though it will be seen that all fractures of the neck of the thigh-bone require the same mechanical treatment, yet, it is probable, that those which are external to the capsule, and those which are partly within and partly external to it, will be found to require less time for the accomplishment of osseous union, than those which are entirely within the synovial membrane. Hence it appears, that it will be advisable, in every instance, to investigate very carefully all the circumstances accompanying fractures of this part of the bone, in order to form an accurate diagnosis; for, if we are not satisfied as to the situation and nature of the fracture, the patient might be confined some time longer than necessary; or, on the contrary, he may be allowed to use his limb too soon. The latter evil should always be avoided, by confining the patient, as long as might be advisable for his safety, under any circumstances; and the first, as frequently as the symptoms will enable us to decide with certainty.

Occasionally, the irritation produced by fractures at the root of the cervix femoris, has, under the usual modes of treatment, destroyed the patient. The prognosis, however, in these cases, might almost always be favourable. If the treatment be good, fractures external to the capsule, and those which are partly within and partly external, unite readily by bone; and, I believe, might be made to do so without shortening, or deformity of any kind, except where the bone is much shattered.

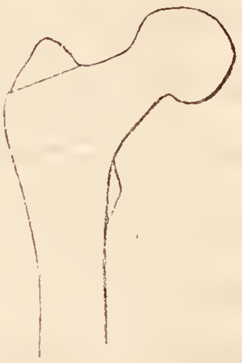
Prognosis in fractures at the root of the cervix femoris.

Sec. 6.—*Fractures of the Trochanter Major.*

Fractures of the trochanter major are sometimes produced by falls upon it; by blows, &c.

Causes of fracture at this part of the bone.

The fracture is occasionally transverse; separating the trochanter close to its junction with the neck, without being accompanied with any injury to this part.

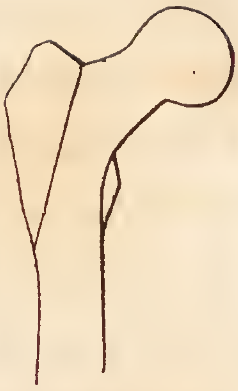


Transverse fracture of the trochanter major.

When there is no considerable laceration of the close covering of the bone, the fractured

Symptoms.

surfaces remain in contact, and consequently the symptoms are sometimes obscure, crepitus cannot easily be felt; and the injury requires more minute investigation, in order to discover the existence of the fracture; but, if the fracture be attended with a division of the soft parts immediately surrounding the bone, the trochanter becomes drawn up upon the dorsum of the ilium, by the action of the gluteus medius and minimus muscles; and then the nature of the accident is very readily ascertained. The trochanter might be moved in different directions independently of the shaft; and when the fractured surfaces of the upper and lower portions of the bone are brought into contact, crepitus might be readily produced, by moving the trochanter, so as to make them rub upon each other. The surgeon might also elicit crepitus by holding the trochanter firmly in his hand, while an assistant rotates and moves the limb in different directions. The foot might or might not be everted in these cases, so that the position of the foot cannot be regarded as a symptom of any importance. The length of the limb is natural.



Oblique fractures of the trochanter major.

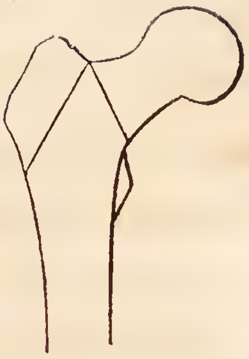
Oblique fractures of the trochanter might pass through the bone in different directions, and might also be accompanied with more or less laceration of the parts by which the bone is surrounded. Some difficulty has been experienced by very able surgeons in discovering oblique fractures of this part of the femur. I suspect, however, that this has arisen, more from the absence of any good report of the symptoms by which they are attended, than from the nature of these accidents.

Symptoms.

When the fracture extends downward and backward, the broken portion is in some instances drawn backwards towards the tuberosity of the ischium, where it might be easily felt through the integuments; if the fracture extends downward and forward, the broken part might be forced in the opposite direction; but, in whatever direction the separated portion is placed, it might be readily moved, independently of the shaft of the bone; and crepitus might be easily produced when the fractured surfaces are brought together, in the manner I have just described. If there be no laceration of the fibrous covering, there will be no separation of the fractured portions; and consequently, in such cases, a more minute examination will be required, in order to discover the nature of the injury. In all cases, the degree of separation of the fractured surfaces will be influenced by the direction of the fracture, and by the degree of laceration of the softer textures, which surround the fractured parts. Numbedness of the limb is a symptom which is observed in some of these injuries. There is also pain referred to the seat of fracture, and more or less tumefaction of the integuments, occasioned by the mischief inflicted upon this part of the limb. The pain is increased by the sitting posture. Abduction, adduction, and rotation of the limb, also, in most instances, increase the patient's sufferings; and, if he be desired to perform these varied movements himself, he sometimes finds that he is incapable of moving the limb in any direction, without more or less additional pain. The foot may or may not be everted; but the limb is neither shortened or lengthened in consequence of the existence of a fracture of the trochanter, unaccompanied with a fracture in any other part of the bone.

Fracture of the trochanter major, with

Fracture of the trochanter major might, as has been said, be attended with a fracture of the neck of the bone, either within the capsule or external to it; or with a fracture which extends partly within and partly external to the capsule.



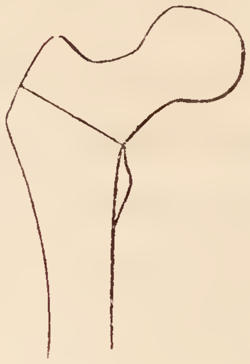
fracture of the cervix.

Symptoms.

When this happens, there are, in addition to those symptoms which are observed when the trochanter only is broken off, the signs which have been described as accompanying fractures of the neck of the bone. The symptoms which indicate the fracture of the cervix vary in some respects, according to its particular situation, and the state of the injured parts; and are also somewhat modified by the existence of the fracture of the trochanter. The patient has less power in the limb when both these injuries have been produced, than when either of them exists alone. The limb feels shattered about the joint, and when the fractures are attended with considerable laceration of the contiguous parts, he has scarcely power to move it at all. In one case which I saw, the trochanter was split into several pieces. The injury occurred in an old man, who died a few days after the accident, in consequence of the complicated mischief which he had sustained at the upper part of the limb, *viz.* a comminuted fracture of the trochanter, and a fracture of the cervix femoris. These injuries have been sometimes erroneously considered as fractures of the trochanter only.

Fracture of the trochanter below the neck.

Occasionally, fractures of the trochanter major pass through the femur, so as to divide the neck of the bone and the trochanter from the shaft, these two parts remaining naturally connected. In these cases, the fracture is situated between the trochanter minor and the lower part of the root of the neck, sometimes taking one direction, and sometimes another.



Symptoms.

When a fracture, thus situated, is accompanied with laceration, the lower portion might be considerably retracted, producing an appearance of shortening, more or less extensive. Crepitus might be easily produced by fixing the trochanter, while as assistant extends (if necessary) the limb, and rotates it. I think it will generally be found, that all power of bending the limb is lost; also of abducting and adducting it. If the fracture be downward and forward, and not attended with laceration, we may expect that the patient will be able to bend the limb considerably. In one case which appeared to be of this description, the fracture of the trochanter was produced by a fall backward; but in what way the force acted, so as to break the bone at this part, I am at a loss to determine. The man, who was 70 years of age, was in the act of drawing a sack of flour from a number of others, with a view to place it on the trucks, made use of to convey the replenished sacks from one part of the chamber to another, &c. and, while exerting himself for this purpose, his foot slipped, and he fell backward; the result was, an oblique fracture of the femur, apparently above the small trochanter, which divided the large trochanter and neck of the bone from the shaft.

Prognosis in fractures of the trochanter.

The prognosis in fractures of the trochanter major is favourable; whether attended with a fracture of the neck of the bone or not, we may anticipate that union will usually take place; and, where there is no comminution, I am of opinion, with proper management, union might be effected in the majority of cases, without any noticeable deformity of the limb. Now and then, the injury sustained is so great as to destroy life, especially in old people.

Sec. 7.—*Fractures just below the Trochanter Minor.*

Causes.

Fractures of the femur, just below the trochanter minor, like all other fractures external to the capsule of the joint, occur at all periods of life, and are produced by the same causes, variously applied, which give rise to fracture in other parts of the bone.

Symptoms.

When a fracture exists in this situation, the upper portion of the bone is commonly somewhat abducted ; and is also drawn forwards, or, in other words, bent upon the pelvis ; so much so, often in loose fractures, as to form nearly a right angle with the lower portion. The cause of this position of the upper fragment, is evidently the contraction of the flexors and abductors of the thigh. The lower portion of the bone is commonly drawn up beneath the upper, sometimes several inches, *(see Plate* V. *Fig.* 2*)* giving rise to the most distressing pain ; and if the two portions are suffered to unite in these positions, the result is often one of the worst varieties of deformity that take place in consequence of fractures of the thigh.

When the fracture passes through the bone downward and backward, *(see Plate* V. *Fig.* 1) the deformity is not commonly so great as when it takes any other direction. In this variety, which is seldom met with, the lower portion of the bone lies anterior to the upper portion. Preternatural motion might be easily felt, also crepitus, when the fractured surfaces are brought together, and made to rub upon each other.

Prognosis.

Fractures of the femur, in this situation, admit of being united with the greatest facility; and without the least deformity of any kind.

TREATMENT OF FRACTURES OF THE UPPER THIRD OF THE THIGH-BONE.

Observations. I shall now proceed to consider the treatment of the various fractures, the causes, symptoms, and nature of which I have endeavoured to lay before my readers in the preceding sections.

The modes of treatment that have been, from time to time, resorted to for the union of fractures of the upper third of the thigh-bone, are so numerous that it would take volumes to give a particular account of them. It appears to me, however, that the different plans and contrivances now commonly advised, possess as many advantages as any which have been hitherto recommended. By giving some account, therefore, of these, I shall do all, upon this subject, that is likely to be useful to the practical surgeon; and all that is necessary to put the junior members of the profession in possession of a knowledge of the inadequacy of the practice which is still recommended and pursued.

After what has been said, within these few years, upon the treatment of fractures of the upper third of the thigh-bone, I fear that any observations which I might be able to make upon it will not be favourably received. At the risk, however, of being thought tedious, I venture to bring this hacknied subject again under consideration; for, though it has occupied so large a share of the attention of scientific men, I find the usual results of these accidents are still opprobria to the profession. Every surgeon, who knows any thing of practice, is aware that patients, with fractures of the cervix within the capsule of the hip-joint, when managed in the ordinary way, do not recover the natural use of the limb. They almost always rise from their beds, often after many months of suffering and confinement, without union of the bone—generally without even the production of an useful ligamentous union; and are for the most part, doomed, for the remainder of their existence, to hobble about, if at all, with the assistance of crutches, or some other mechanical support; that though union by bone often takes placew hen the fracture is in the neck external to the capsule, or at the inferior part of the trochanter below the neck, or when it is just below the trochanter minor, yet the results in all these cases are, after long and severe suffering, usually deformity of the limb, and consequent lameness. The deformity, in some instances, is not very great; but cases of union without deformity, when the fracture is in either of these situations, are very rarely seen. It might be said, that more or less deformity is a general occurrence. I have never seen an instance of fracture of the neck, or of the trochanter below the neck, accompanied with laceration sufficient to allow the ends of the bone to ovelap, united by the employment of any of the usual means, without considerable retraction of the limb; and, generally, more or less eversion of the foot. When the fracture is just below the trochanter minor, the retraction is sometimes not less than seven or eight inches; accompanied with an angular displacement of the fractured parts, now and then so great, that it has been deemed expedient, in order to enable the patient to walk again, to cut down upon and amputate the projecting end of the upper portion of the bone. It might be supposed that, such results happen only in the practice of surgeons who do not know their profession. This I deny. The worst case of deformity I ever saw, after a fracture below the trochanter minor, occurred in the practice of a surgeon in this town, who is well known to the public, and who stands very high in his profession. Speaking of this injury, Sir A. Cooper says, "it is a difficult accident to manage, and miserable distortion is the consequence, if it be ill treated." Not only, however, do we find non-union, great deformity, and consequent claudication, result from fractures of the upper third of the bone; but on some occasions, the irritation produced by the ragged ends of the bone, pricking and tearing the soft parts with which they come in contact, is so great as to destroy the patient. Surely these are evils, the causes of which require to be investigated a little more. Do they arise from the nature of these injuries? or do they arise from the imperfection of the treatment resorted to for their cure? Before these questions can be determined, it will be necessary to consider the usual plans of treatment, in order to ascertain how far they are capable of answering the indications which these accidents present; and if it can be demonstrated that the different contrivances commonly employed do not answer them, it will be evident, that we ought not to expect, from their use, any other results than those which we observe; and if, on the contrary, it can be shown that there are means in existence, by which union without deformity can easily be obtained; it will be seen, that the usual consequences of these accidents should not be attributed to any thing particular in the physical condition of the injured parts, but to the imperfection of the means by which their cure is attempted.

The treatment which the fractures I have mentioned require, in order to arrive at successful terminations, is so similar, in many respects, that I have been induced to arrange them under one head, *viz.* fractures of the upper third of the thigh-bone. The management of fractures of the cervix femoris, however, differs, in some minor particulars, from that which it will be advisable to have recourse to for fractures of the trochanter major, and for those which occur below the trochanter minor. I shall, therefore, first speak of the treatment of fractures of the cervix; and then proceed to point out the ordinary treatment and differences which it will be proper to observe in the management of fractures of the trochanter major; and those which are met with just below the trochanter minor.

Sec. 8.—*The usual Modes of treating Fractures of the Cervix Femoris.*

Indications.

The principal part of the treatment of fractures of the cervix femoris is mechanical, whether the fracture be within or external to the joint; and in order to understand the imperfections of the usual plans of treating these cases, it is desirable to notice the indications which should be answered by mechanical means, with a view to bring about useful union of the bones. These are, 1st, to keep the limb of its natural length; 2d, to keep the limb in the bent position; 3d, to prevent eversion or inversion of the foot; 4th, to keep the trochanter a little raised; 5th, to keep the fractured surfaces in close apposition; 6th, to prevent the fractured surfaces from moving upon each other. These indications are so self-evident, that I believe it would be superfluous to offer any comment upon them: they are so important, too, that unless they are fulfilled, it will be in vain for us to expect that our cases will terminate favourably.

I shall now enquire, how far any of the

modes of treatment, commonly resorted to, are capable of answering these indications. In performing this part of my duty, which I would willingly pass over, I would be understood, not to contend against men, but against doctrines and plans, when they appear to me to be inconsistent with the soundest principles of surgical science.

On the use of the short splints.

I have seen the short splints, as they are called, sometimes employed in the treatment of fractures of the neck of the thigh-bone; but I cannot suppose that they are ever used, by persons who have any knowledge of the anatomy of the parts, with a view to benefit the patient; I shall, therefore, say nothing further respecting them in this place.

On the use of the double-inclined plane.

The double-inclined plane, or common fracture-box, is frequently made use of in the treatment of these injuries; but I cannot help thinking, that this apparatus is wholly inapplicable in the management of such cases, if it be the surgeon's intention to benefit the patient by the employment of mechanical means.

When this apparatus is used, it is placed under the limb, upon the bed or mattress; and made to retain the leg and thigh in the bent position, and to keep the foot upright. Thus, the whole of the limb, below the fracture, is effectually supported; but what influence has this contrivance upon the upper portion of the bone, which moves simultaneously with the pelvis?—does it prevent the movements of the pelvis? No; it has no influence upon this part of the body, which might be considered advantageous, consequently, none which is calculated to restrain the movements of the upper portion of the bone. The pelvis is allowed to move freely, independently of the apparatus and of the limb; and, as long as this is permitted, the pelvic portion of the fractured thigh-bone cannot be kept at rest.

This apparatus not only does not prevent motion of the fractured parts, but also fails to prevent the fragments from passing each other; and, consequently, fails to prevent shortening of the limb. This will be immediately perceived, when it is considered that the nates sink into the bed or mattress; and, at the same time with the whole trunk, gravitate towards the foot, while the apparatus, and all that part of the limb below the fracture, remain stationary, or as they were first placed.

Again, this apparatus does not keep the fractured surfaces in close apposition; for, as the pelvis and the apparatus are unconnected, and as the pelvic portion of the bone moves simultaneously with the pelvis, there must, consequently, be a greater or less degree of separation produced between the broken ends of the bone in one direction or another, or more or less stretching of the soft parts by which they may happen to be connected; and this separation of the fractured surfaces, or this stretching of the soft parts, must be proportionate to the extent of motion given to the pelvis, from whatever cause that motion might be effected. It might be said, that a belt placed round the pelvis, or a splint applied to the outer side of the limb, would have the effect of keeping the fractured surfaces together. This would, indeed, be the case, if retraction were prevented; but, as the fractured surfaces are allowed to pass each other, a belt or splint thus applied, would be likely to, and I have no doubt, often does, force the serrated edges of the fractured ends against the inflamed capsule of the joint; and thus produce a degree of suffering which can rarely be borne by the patient. The pain occasioned by these means, when the injury is in the recent state, is often very great; as I have repeatedly witnessed in the practice of surgeons who are accustomed to employ half measures.

Inference.

From what I have said, I think, it will appear, that the double-inclined plane, or fracture-box, is not calculated to answer the indications above-detailed. It does not afford a steady support to the trochanter, so as to keep that part of the limb in its natural position; it does not prevent retraction of the limb; it does not keep the fractured surfaces in close apposition; it does not prevent the fractured ends from moving upon each other; it gives the surgeon no command over the fractured ends of the bone; and, consequently, he who can obtain no better means, ought not to be considered answerable for the result of a single case, because his efforts are resisted by mechanical forces, over which he has no control.

Desault's and Boyer's splints.

There are two other modes of treatment, also, much resorted to, whose principal effects I shall now mention. One of these is recommended by Desault, and the other by Boyer. When the treatment, advised by either of these gentlemen, is adopted, the limb is placed in the straight position.

Desault's splint.

When Desault's splint is employed, the band, *(a, Fig. b,)* which is intended to exert its influence upon the tuberosity of the ischium, shifts its situation, so as to lie between it and the upper part of the thigh, where it soon gets into a roll, which causes much pain; and, if its operation be continued in such a manner as to have the effect for which it is applied, it often occasions ulceration, and sometimes gangrene. The difficulty of acting upon the tuberosity is much greater in women than in men, in consequence of the greater quantity of cellular and adipose substance, which is generally found in females about this part. This band, when exerting its influence, acts upon the large vessels of the thigh, and gives rise to considerable tumefaction of the limb, unless great care be taken to support it by means of a bandage from the toes to the groin. It passes, too, over the fractured part, and during the inflammatory stage of the injury, produces so much pain, that its operation cannot be borne. The action of the band which is placed upon the foot is, also, sometimes very injurious. This frequently occasions gangrenous spots, which are sometimes so large, as to denude a considerable portion of the tendo-achillis, and of the tendons of the extensor muscles of the toes. The tendons, in some in-

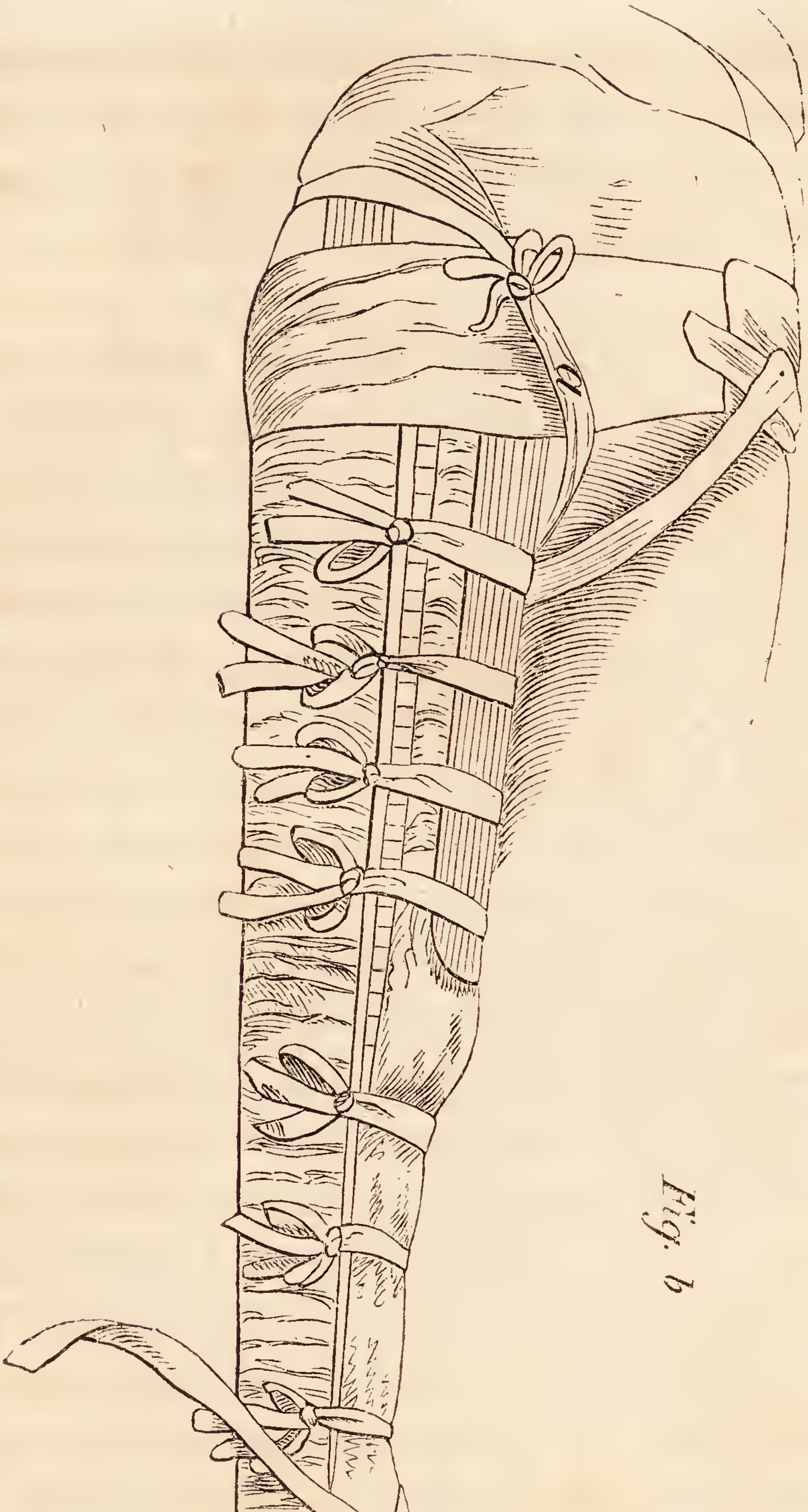


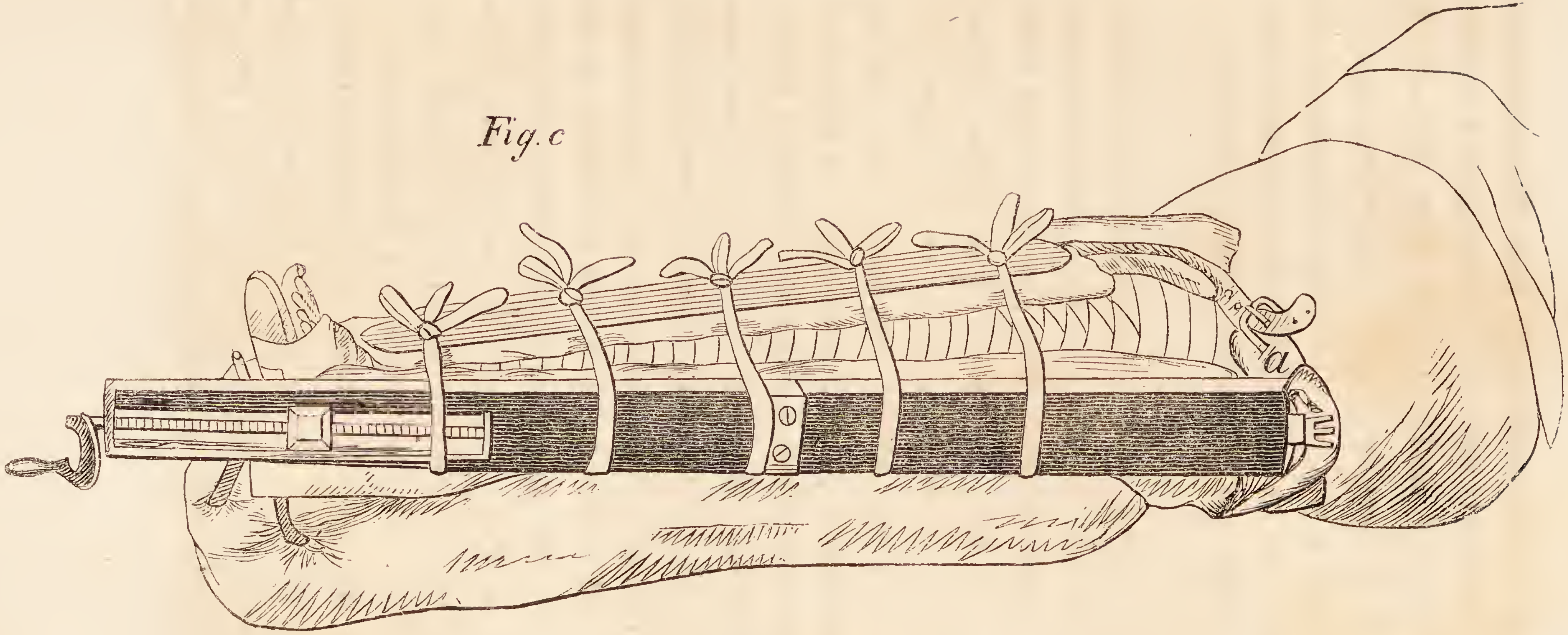
Fig. b

stances, slough, and the bones which they are destined to act upon remain motionless. The irritation occasioned by this plan is, in some cases, so great as to destroy the patient.

Boyer's apparatus.

Boyer's apparatus, *(Fig. c,)* which is considered an improvement upon Desault's, is open to the same objections, though not in so great a degree. This apparatus might appear to some surgeons very applicable in the management of fractures of the cervix femoris; but, when its action is minutely considered, I think it will be perceived, that it cannot answer the indications that have been mentioned. Boyer endeavoured to make the thigh-strap *(a)* of his apparatus, so that it should not slip off from the tuberosity of the ischium. I believe, however, that those who have seen it employed, will be able to bear testimony, that it does not maintain the situation which it was intended to occupy. This strap, like Desault's bandage, gets off the tuberosity of the ischium, and lies upon the upper and inner part of the thigh, where it compresses the large vessels, and acts upon the fractured part. Hence arises tumefaction of the limb; and as long as there is any active inflammation in the seat of injury, so much pain is occasioned in the fracture, by extending the

Fig. c



limb with this contrivance, that the influence of the thigh-strap cannot be borne, in a manner calculated to enable the surgeon to keep the limb of its proper length. Boyer was sensible of this evil; and he, therefore, recommends the adoption of means which do not extend the limb, while the fracture is in the recent state.

The contrivance recommended by Desault, and that by Boyer, not only give the patient great inconvenience, but are, also, very inefficient. It will be seen, that when Boyer's apparatus is employed, the counter-extending band or strap, acting obliquely upon the upper and inner part of the thigh, is calculated to force the pelvic portion of the bone upward out of its natural position; its action, too, tends to force the shaft of the bone outward, and to press the soft parts between the fractured surfaces. It might be said that the shaft of the bone is not forced outward when Desault's splint is used, though the operation of this splint has a tendency to impel it away from the pelvis; because there is a bandage passed round the pelvis, which might be made to counteract this effect of the thigh-strap, and thus keep the shaft of the bone in a proper line; but though a bandage placed round the pelvis, in the manner pointed out by Desault would counteract, in this respect, the oblique thigh-strap; yet, I presume, its operation would be seldom beneficial; for as the limb is not kept extended to its proper length, the fractured surface of the trochanteral portion of the neck would often be brought into contact with the soft parts; and, therefore, instead of assisting nature in the production of union, the bandage would have the effect of irritating the patient, without any probability of benefiting him, even, if he should be able to bear the pain which it occasions.

Inference.

Boyer's apparatus keeps the foot upright, but it does not properly answer any other indication; and I cannot perceive that this one, or any other which I have noticed, is effectually answered by the plan which Desault recommends. It seems to me, that any advantages which are obtained by these modes of treatment, are more than counterbalanced by the evils which they occasion.

Observations.

Such are the contrivances that are, at the present day, employed, with a view to restore to patients who have fracture of the cervix femoris, the use of their limbs. I have seen a great variety, but I am not aware of any splint or fracture-box, commonly resorted to, which offers more advantage than those I have mentioned. Is it, then, to be wondered at, that we meet with so many cases of non-union in this situation? I think, on the contrary, that it is rather surprising, that union takes place as frequently as it does, even in fractures external to the capsule.

Sir Astley Cooper's plan.

After trying unsuccessfully various splints and apparatuses, Sir Astley Cooper has come to the conclusion, that it is better, when the fracture is within the joint, to treat the patient in such a manner as to enable him to leave his bed, as soon as the inflammation occasioned by the accident has subsided, without any regard to the union of the bone. A conclusion, to which any surgeon was likely to arrive, who could obtain no better means to assist him in his curative intentions, than those to which I have alluded; and, I am not sensible that Sir Astley was in the habit of employing contrivances, which could in any respect be considered more efficacious than the fracture-box, or Boyer's apparatus. If he had used better means, I presume we should have found them noticed in his book.

Sir Astley Cooper's treatment.

Having, after long experience, made up his mind, that patients, with fracture within the capsule, were not benefited by any apparatus with which he was acquainted, and that they sometimes suffered from long confinement under their use, Sir Astley was led to say, "if I sustained this accident in my own person, I should direct, that a pillow should be placed under the limb throughout its length, and that another should be rolled up under the knee, and that the limb be thus extended for ten days or a fortnight, until the inflammation and pain have subsided. I should then daily rise and sit up in a high chair, in order to prevent a degree of flexion which would be painful." This mode of treatment is advised, under the idea, that no benefit will accrue to the patient by longer confinement; but even under this consideration, the plan which Sir Astley has so strongly recommended, by stating that he would follow it in his own person, seems to me not without its attendant evils; and is not, perhaps, for reasons which I shall now mention, the best that might be adopted, even by those gentlemen who still hold the opinion, that it is useless in such cases to attempt to unite the bone by the intervention of callus, or any other substance.

After mature consideration, I am at a loss to

Observations upon.

discover the propriety of placing a rolled pillow under the knee, as advised by Sir Astley Cooper, *(see Fig. d.)* The indication which this pillow would answer is clear—it would prevent, in a great measure, that stiffness which usually takes place in the knee-joint, when the limb is confined for a long time in the straight position; but, according to this plan, long confinement is not required, and the degree of stiffness which takes place in ten days or a fortnight, is so trifling, that it is scarcely worthy of our consideration. Granting, however, for a moment, that it might be of some use to place a pillow under the knee; yet it will be immediately seen, that the advantage gained by it in this respect, would be more than counter-balanced by the injurious consequences which must arise from the practice.

The pillow is doubtless placed so as to support the limb, in the first instance, in a position apparently the most comfortable to the patient; but, is a pillow of a nature to maintain it so, or is it calculated to keep up extension of the limb? To both of these questions I must give a decided negative. The pillow yields to the superincumbent weight, and what is the result? In proportion as the pillow gives way, the limb gravitates

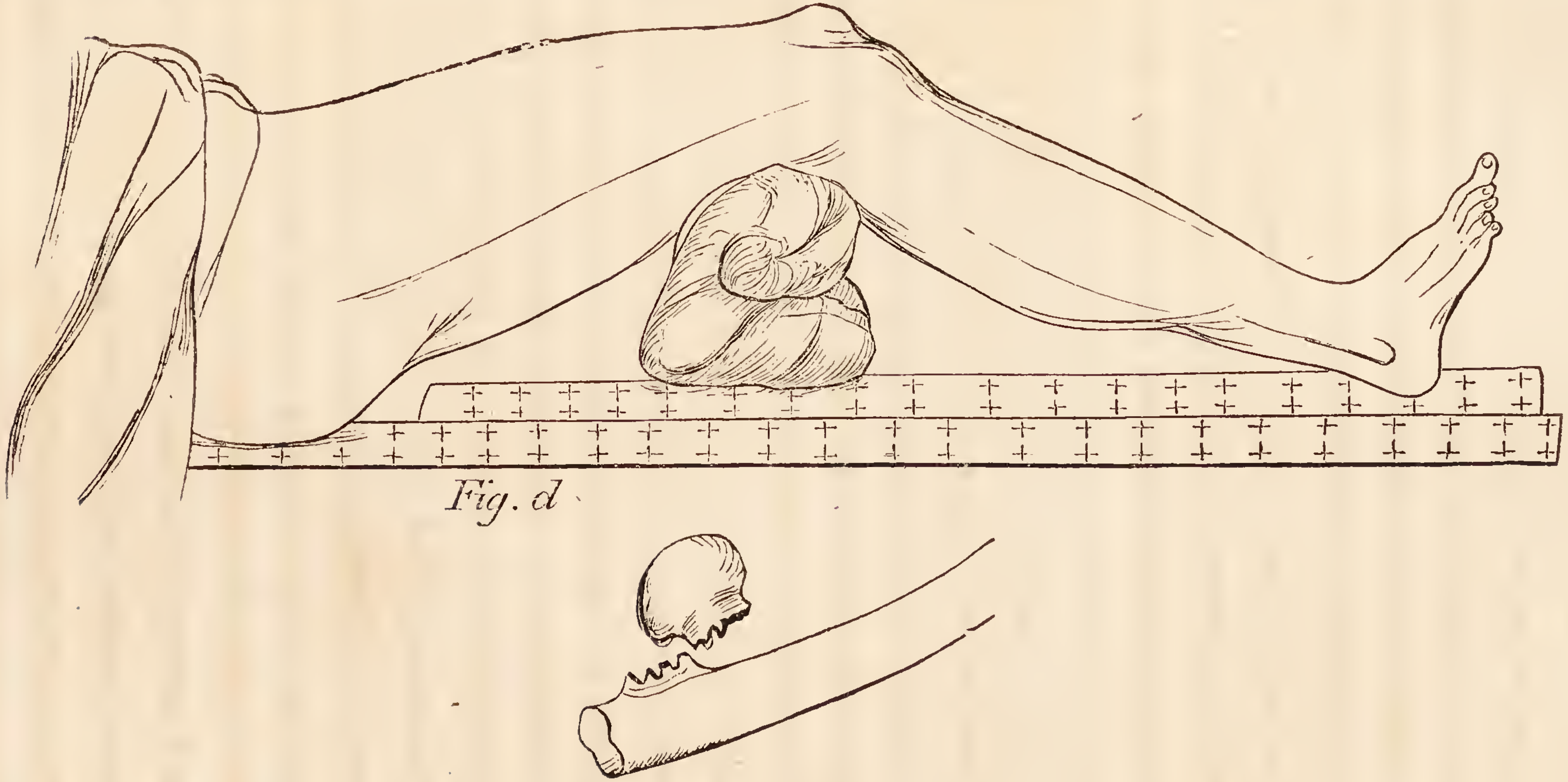


Fig. d

towards the hip-joint, as is represented in the diagram where this mode of treatment is shown; but here the limb has lost its natural support, in consequence of the fracture of the neck of the bone, therefore it continues to gravitate along the side of the pelvis towards the bed, till its further progress is arrested by the resistance of the soft parts. Thus, the soft parts are stretched; and, if there were no reason to apprehend the occurrence of shortening from the nature of the accident, this is evidently a mode of treatment which is likely to effect it, even without the operation of any other cause. But there is another cause, whose operation militates against this practice—I mean the gravitation of the body towards the foot of the bed. Thus, then it will be seen that, under this treatment, there are two causes constantly tending to make the fractured surfaces pass each other, independently of the action of the muscles of the limb; *viz.* the gravitation of the limb towards the pelvis, and the gravitation of the trunk towards the foot of the bed. The ragged ends of the bone are in this way, constantly driven against the soft parts; and if we add to these forces the powerful contraction of the muscles which tend to retract the limb, we shall not wonder that it becomes retracted, but rather be surprised if we were to meet with a case, thus treated, not attended with considerable shortening; for if the investing membranes should not be torn through at the time of the accident, this method is likely to cause them to ulcerate.

Inference.

From the view which I take of this method, I should say, with every consideration of respect for Sir Astley's surgical acquirements, that the tendency of it is injurious, even if the patient be permitted to leave his bed at so short a period after the accident as he has recommended. It produces separation of the fractured surfaces, which might otherwise remain in tolerable apposition, and thus increases the claudication, which would otherwise supervene; it is, therefore, in my opinion, a plan of treatment which ought never to be advised.

Indications not answered.

I need not say any thing to shew the inadequacy of the pillows to keep the limb quiet; for, as no beneficial effect is expected to arise from surgical treatment, except in the employment of means to subdue the inflammation, no attempt is made to secure the parts from motion, or to answer effectually any other indication that I have observed; but I hold it an axiom in surgery, that, if we are satisfied that no good can be obtained, we should be doubly careful that we do no mischief—an axiom which I cannot help thinking is overlooked when this plan of treatment is pursued.

SEC. 9.—*The Author's Mode of treating Fractures of the Neck of the Thigh-bone, with Observations upon Mr. Harrold's and Mr. Earle's Plans.*

I have now given a concise account of the indications of cure, and of the usual plans of treatment in fractures of the neck of the thigh-bone, both within and external to the capsule. I might have mentioned various other splints and fracture-boxes that have been employed by different surgeons; but, as I cannot discover that any of these differ in their action, in any material point, from those I have noticed, I shall pass over them in silence, leaving it to those who may feel disposed to advocate their use.

If I have succeeded in making myself intelligible, I think it will be granted, by the candid surgeon, that the plans which are commonly resorted to in the treatment of fractures of the cervix femoris, are not of a nature to assist us, in any considerable degree, in bringing about those results which it is our business to obtain.

Constitutional treatment.

In the management of fractures of the neck of the thigh-bone, after the active inflammation is got under, internal medicines are not required, except with a view to remove disease, or to maintain the health of the patient. When there is much inflammation, aperient medicines, cautiously administered, assist very much in subduing it. During this state, topical bleedings and evaporating lotions may be sometimes resorted to with advantage; but great care should be taken not to reduce the action of the part too much, as this would only tend to retard the uniting process.

Treatment of fractures of the cervix femoris, within and external to the capsule.

The most important part of the treatment is mechanical; and this is the same, whatever may be the situation or nature of the fracture. The only difference to be noticed is in respect to the time which might be required for the completion of osseous union in the several varieties of fracture; and the degree of tumefaction, &c. that may accompany any individual case. In the present state of our knowledge, it cannot be determined with nicety how far it may be necessary, for the accomplishment of bony union, to persevere in our curative measures longer, in the treatment of fractures within the capsular ligament, than we should think it advisable in the management of those fractures which occur in the cervix external to the joint; but, as it is probable that the process of union will go on more slowly when the fracture is within the synovial membrane, for reasons which have been already mentioned, than when it is external, it will be prudent and safe, till further light is thrown upon the subject, to confine the patient ten days or a fortnight longer in these cases than will probably be required for fractures situated at the root of the neck external to the capsule.

Description of the author's fracture-bed.

I have attempted to supply the deficiencies which I had observed in the usual mechanical contrivances, in the construction of an apparatus which I employ in the management of fractures of the upper part of the thigh-bone, and for various other purposes. This apparatus *(Fig. e,)* I call a fracture-bed, which, when properly fitted up, consists of a frame which has a joint near the middle, and which is made to support four pieces of board, long enough, when connected, for an adult to rest upon in the extended position; of a foot-board, pelvis-strap, mattress, and

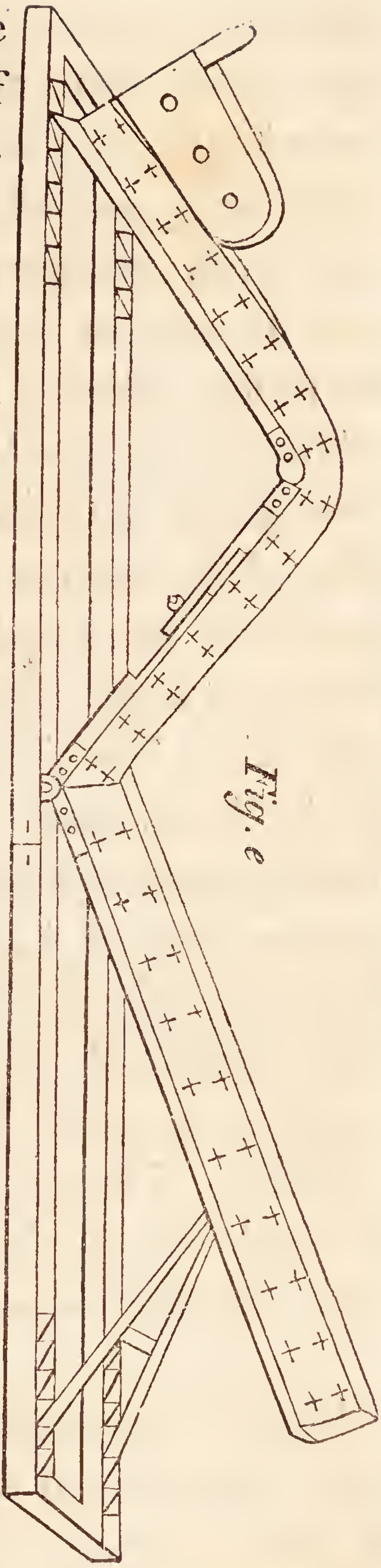


Fig. e

a convenience to receive the fæces. The two pieces of board which form the middle plane, are made to slide upon each other, so that this plane might be adapted and fixed by screws attached to it, with the greatest accuracy to the natural length of the patient's thighs. In this plane, there is an opening of a form and size to receive the receptacle for the fæces. When the receptacle is in the hole, it is retained in its proper position by a shelf, which shuts up so as to close the opening when the receptacle is removed. This plane is connected to the upper and lower planes by rule joints; which allow the three planes to be placed in connexion upon the frame, at any angle that might be required. The joint formed by the middle and upper planes rests upon the middle of the frame when the bed is used. The upper plane may be kept raised from the frame, so as to incline towards the foot of the bed, by means of a supporter appended to its under surface. The loose ends of this supporter are received in racks formed in the upper end of the sides of the frame. At the lower end of this plane the pelvis-strap is attached. The lower end of the lower plane is received in racks formed in the sides of the lower end of the frame, which support it, so as to make it form with the middle plane any angle that the surgeon might deem advisable. The foot-board, which is connected to the lower end of this plane, answers the double purpose of retaining the foot in its proper position, and of keeping the bed-clothes from pressing unpleasantly upon the toes. The mattress consists of two portions, which are sown together, so as to form a joint like that of a paillasse. The part upon which the trunk rests is double the thickness of that upon which the lower extremities are placed.

Observations upon Mr. Earle's fracture bed in comparison with Mr. Harrold's and the author's.

The first fracture-bed that I know of, which was recommended with a view to fix the pelvis, is that invented by Mr. Harrold. Soon after Mr. Harrold published an account of his bed, Mr. Earle introduced the fracture-bed which bears his name. Mr. Earle has simplified the contrivance recommended by Mr. Harrold, but it does not appear to me, that he has added any thing to its efficiency ; on the contrary, as far as I am able to judge, Mr. Earle's bed is less perfectly adapted to answer the indications which are noticed in fractures of the thigh than Mr. Harrold's. I need only allude to the mechanism of the middle plane in the two contrivances, in order to justify this remark. By referring to the published accounts, it will be seen, that Mr. Harrold's bed admits of being adjusted with nicety to the length of the thigh without any adventitious support ; but Mr. Earle's frequently requires the unstable and inconvenient assistance of wedges of wood, which he recommends to be placed beneath the calf of the leg, in order to make up for this deficiency in the construction of his fracture-bed. This mode of adapting the middle plane to the natural length of the limb, is, in my opinion, injudicious ; and, though it might answer very well in the hands of Mr. Earle, I believe it will, in general, be found much less certain in its effects, and much more difficult to manage, than the method which Mr. Harrold has resorted to in the construction of the fracture-bed which he employed.

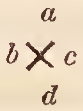
The fracture-bed which I have described differs, in several important particulars, from Mr. Earle's. In the only model of that gentleman's fracture-bed that I had seen, when mine was constructed, there was no contrivance for altering the length of the middle plane; consequently the bed appeared to me to be applicable only to limbs of one length. Mr. Earle has now imperfectly got over this evil, by making the middle plane so that it might be elongated or shortened, but not so as to admit of its being nicely adjusted to limbs of different lengths. The least difference that can be made in the length of this plane, according to its present construction, is about an inch; so that if any space less than this is required, it must be obtained by the introduction of "wedges of wood," or some other means. This imperfection gives rise to injurious consequences, which, upon a cursory consideration, might not appear, but which, after further investigation, will be evident. For instance, if the limb be shortened half or three-quarters of an inch, there is no provision made for its elongation, in some cases, except by the introduction of pieces of wood under the calf of the leg. These are likely to produce very uncomfortable pressure at this part upon which the extending influence is exerted.

They sometimes, also, get out of place, and allow the limb to become again retracted. The plan which Mr. Earle has advised to fix the pelvis, cannot, it appears to me, be depended upon, and might be sometimes productive of mischief. For example, when the fracture is in the neck of the thigh-bone, the bandage, which he directs to be carried across the upper parts of the thighs and fastened to the bed, might act injuriously upon the shaft of the bone, forcing it from its natural relative line with the pelvic portion. I have also noticed, what appears to me, a great imperfection in the construction of the mattress which Mr. Earle employs; which consists in its being of equal thickness throughout, and without a joint in the middle. The consequence is, that when the planes of the bed are bent upon one another, the mattress gets into folds just at the parts where the pelvis rests. Such irregularity in the surface would be likely to produce painful pressure, even if the body were kept in the horizontal position; but, when the limbs and the body are raised upon the planes, so as to gravitate upon the pelvis, as is the case when this bed is employed, the pain, in some instances, at the posterior part of the sacrum, is too great to be borne with safety. The thickness of the mattress, also, at the angle, formed by the middle and lower planes, is such as to form a surface much too large to be well received in the ham, when the leg is bent upon the thigh; consequently, this part of the mattress has the effect of forcing the fractured end of the lower portion of a broken femur forward out of its natural line. These are the principal evils which I have observed to arise from the employment of Mr. Earle's bed, in the management of fractures of the thigh. But, independent of every other consideration, this bed, though more simple than Mr. Harrold's, appears to me to be more complicated than is necessary for the successful treatment of fractures of the thigh. The indications I have noticed might be answered in a much better manner, with means far more simple in construction and in application; and, at the same time, much more portable, than Mr. Earle's contrivance.

The evils I have mentioned, and others of minor importance, led me to consider this bed as inadequate to answer the purposes which the surgeon should have in view, in the management of fractures of the cervix, or any other part of the femur. I was, therefore, led to turn my attention to this subject, in order to contrive some apparatus by which the indications

I have detailed might be more effectually answered, than by any of the plans which I had seen. In my endeavours to accomplish this desideratum, I have succeeded beyond my warmest expectations, in constructing a fracture-bed, which has the advantages of being more simple, more portable, and, at the same time, more efficacious, than any other with which I am acquainted. I do not know any attainable indication in these cases, which it does not enable the surgeon to fulfil most effectually; but, how far I may have performed the task which I imposed upon myself to the satisfaction of the profession, future experience will decide.

Application of the author's fracture-bed, as for fractures of the neck of the thigh-bone.

When it is intended to use this fracture-bed for fractures of the neck of the thigh-bone, within or external to the capsule, three boards should be procured, long enough to lie across a common bedstead, the sacking having been removed. One of these boards should be placed across the bedstead at the head, another about the middle, and the other at the foot. The frame of the fracture-bed should be placed upon these boards, so that the joint may be supported by that which lies in the middle. The planes of the fracture-bed should then be placed upon the frame, with the joint, formed by the middle and upper planes, resting upon the middle of the frame, in places made to support it. The upper plane should be raised to an easy position, and the lower and middle planes should be made to form a double-inclined plane; which is done by putting the lower end of the lower plane to rest in two of the notches of the rack, made at the sides of the lower end of the frame. I usually choose the second at each end. This being done, the mattress should be laid upon the planes, with the thick part upon the upper plane, and the thin part upon the middle and lower planes. The joint of the mattress should lie over the joint formed by the upper and middle planes, with the edges, which are sewn together, placed downward. A blanket and sheet should now be thrown over the mattress and tacked to its edges, so that they may be prevented from getting into folds under the patient. A hole must be made in the blanket and sheet to correspond with the hole in the mattress. This might be done by making a cross cut, thus, 

The corners, *a*, *b*, *c*, *d*, should be turned down, and tacked to the sides of the hole in the mattress, so that there may be no seams to hurt the patient. The foot-board should now be placed in the hole made in the lower plane corresponding to the injured side, and the pad placed in the hole in the mattress.

These preliminaries being arranged, the fracture-bed might be considered ready for use. The patient should be placed upon it, so that the perineum might be opposite the hole in the mattress. As the patient lies upon the bed with the limbs over the middle and lower planes, and the nates resting in the angle formed by the middle and upper planes, the surgeon should measure both limbs from the anterior superior spinous process of the ilium to the base of the patella; and, if the injured limb be retracted, the middle plane should be elongated sufficiently to make this limb of exactly the same length as the other. This being done, this plane should be firmly fixed at its proper degree of elongation by the retaining screws which pass through the two portions of it. The limb, having a spiral bandage round it, neatly applied from the toes to the knee, should now be fixed upon the planes with the foot between the legs of the foot-board. This is done by means of another portion of bandage, which is carried twice round the ancle, the two ends are then crossed upon the instep, and passed under the legs of the foot-board, brought together, and tied at the bottom ; so as to keep the leg and thigh firmly fixed upon the respective planes of the bed. While this is being done the surgeon should take care that the patient does not shift the pelvis. Thin pads should be placed between the sides of the sole of the foot and the legs of the foot-board, to keep the foot upright. A thin pad should also be placed between the upper part of the back of the thigh and the mattress, to raise and support the trochanter major. The limb ought now to be of *exactly the same length as the sound one, and the foot perfectly upright.* This having been ascertained, the surgeon places a splint padded on the outer side of the thigh, long enough to extend from the knee to the pelvis ; and then buckles the pelvis-strap round the pelvis, just below the superior anterior spinous processes of the ilium ; having previously carried the end of the strap on the injured side over the upper end of the thigh-splint. The degree of tightness of this strap should be regulated, at all times, by the particular state of the fracture. The splint should be fixed to the thigh, at the other end, by a bit of bandage passed lightly round the thigh over it. When the limb is thus secured, all the indications I have noticed are most fully answered.

The limb is supported in the bent position, which is the easiest position, and also prevents that long-continued stiffness of the knee which is observed to arise from keeping the limb for a long time straight. The limb is maintained of its natural length, and, by the same means, the body prevented from gravitating so as to injure the skin at the back of the pelvis. The foot is kept upright, and fixed in such a manner as to prevent the limb from moving; and the pelvis being, at the same time, fixed by the pelvis-strap, the fractured ends of the bone are kept perfectly free from motion. The trochanter is supported, and the fractured surfaces, having been brought together, are maintained in close apposition by the pelvis-strap; which, at the same time that it fixes the pelvis, passes over and acts upon the upper end of the splint; which is placed along the outer side of the thigh, so as to be the medium through which the pelvis-strap presses the trochanter major towards the pelvis; and with it, of course, the fractured surface of the trochanteral portion of the bone.

The following cases will shew with what facility fractures of the neck of the thigh-bone are managed by the use of this fracture-bed.

A bricklayer's labourer, about 40 years of Case unaccompanied with laceration.

age, was brought to St. Thomas's Hospital, in consequence of an injury which he had received in the upper part of the right thigh. He stated that he fell from the wheel of a cart three days before his admission into the hospital, in such a manner as to strike the trochanter major forcibly against the ground. He got up, and walked about twenty yards, and then worked at making mortar for two hours; in the course of which he lifted two buckets of water without suffering severely. The limb had now become stiff and very painful, so that he was obliged to leave his work; but the inconvenience he experienced was not so great as to prevent him from walking, with the assistance of a stick, upwards of half a mile to his lodging; but the limb felt very weak, and the pain which he experienced in the groin, thigh, and knee, during this exertion, was extremely severe.

The professional gentleman who saw this man a short time after the accident, informed me, that he complained very much when the limb was examined; but there was no crepitus perceptible, nor was the limb at all shortened.

He was brought to the hospital on the third day after the accident, and I had an opportunity of examining the limb the moment after he was warded. There was now severe pain in the hip-joint, apparently dependent, in a great measure, upon inflammation of the capsule, which was considerably distended; as was evinced by a prominent fluctuating swelling in the front of the joint. He had, also, great pain in the knee, and the whole limb was weak and useless. The pain in the groin and knee was much increased when the limb was moved, especially when it was rotated inward. There was no swelling perceptible, except that which appeared in the groin. The limb was everted but not shortened. The eversion, however, had existed for a long time, and was produced by a former injury in the joint, or its vicinity; it did not, therefore, tend to throw any light upon that, under which he was at this time labouring.

The history of the case altogether, led me to suspect the existence of a fracture of the cervix femoris, unattended with laceration of the surrounding parts, and I, consequently, examined the limb very cautiously, with a view to elicit crepitus; but I did not succeed in producing it. In my attempts to discover this symptom, I carefully abstained from any violent measures, in order that the close coverings might not be lacerated. I mentioned my feelings respecting the case to Mr. Green, under whose care the man was admitted; and he saw the patient immediately, had him placed in a common bed, and ordered twenty leeches to the groin. The leeches were applied, but they had but little effect in reducing the inflammation; the same number was, therefore, repeated four times within the first twelve days after he came to the hospital. At the end of this time, the inflammation and pain had greatly subsided; and, on the fifteenth day, the limb was again carefully examined by Mr. Green and myself, in company with many of the gentlemen attending the hospital. It continued everted, but no retraction had taken place. If there were any difference in the length of the two limbs, it was certainly in favour of that which was injured. The crepitus of fracture, however, discovered by rotating the limb, was very evident; but the part of the cervix that was broken could not be precisely determined. Still, as the symptoms which often accompany fractures of the cervix external to the capsule, namely, ecchymosis, and diffused swelling, were not present, and as the inflammation appeared to be confined to the joint, we thought it probable that the fracture was principally within the capsule.

The man was now placed upon my fracture-bed, where he remained three weeks. At the end of this time, the limb was again examined, and the bone appeared to be united; he was now placed upon a common bed, where he continued only for a few days.

At the end of a month from the time he was taken from the fracture-bed, he was able to walk the wards with facility; without any assistance whatever, and with only a slight limp. There was no shortening of the limb; and it is worthy of remark, that the foot, which was much everted before the accident for which he was admitted into the hospital, was now brought to its natural position.

Remarks.

It was intended to keep this man upon the fracture-bed another fortnight, but finding his limb strong, he determined not to remain in one position any longer. His leaving the bed so early was considered an imprudent step, as the union might have given way, but by doing so, he brought to light a most important fact; *viz.* that fractures of the neck of the thigh-bone sometimes unite very rapidly under proper management, when the investing membranes are not much torn.

Case with laceration.

Geo. Franks, æt. 30, was admitted into St.

Thomas's Hospital, with a fracture of the neck of the thigh-bone, which had been just produced by a fall upon the trochanter. On his admission, the most prominent signs of fracture of the neck of the thigh-bone; *viz.* eversion and retraction of the limb and crepitus, were not present. He had, however, considerable pain at the upper and inner part of the thigh, which came on immediately after the accident, and was accompanied with great diminution of power in the limb. He could move it in different directions, but not without increasing his sufferings. There was slight tumefaction at the upper part of the thigh, but no ecchymosis. He was placed upon a common bed, in the horizontal position, but no apparatus was employed.

A fornight after the accident, *retraction of the limb took place to the extent of an inch and a half*, which was ascertained by means of a graduated measure, carried from the superior anterior spinous process of the ilium to the base of the patella; the foot was everted, and all the other signs of fracture of the neck of the thigh-bone, which are usually described, and which I have said accompany fractures of this part, when attended with considerable laceration, were very strongly marked; with the exception of crepitus, which was never distinctly felt, either before or after the retraction was observed.

Mr. Travers, under whose care this man was admitted, now desired, that he should be subjected to the plan of treatment which I have recommended, and politely requested me to superintend the management of it.

The patient was placed upon the fracture-bed on the eighteenth day after the accident, where he remained for eight weeks, at the expiration of which, the limb was examined, and it was considered that union had taken place; but, whether the union was by bone or ligament, it was not easy to decide. The foot was in its proper position, and the limb nearly as long as the other—the degree of retraction which existed being *less than a quarter of an inch,* which was discovered by measuring the limb with the graduated tape as before. The apparent length of the two limbs was the same. He left the hospital in about three weeks after he was removed from the fracture-bed, with powers sufficient to walk without any artificial aid, but not without a slight limp. Since he left the hospital, he has been employed in a situation where he was sometimes required to lift, and occasionally to carry four hundred pounds weight at a time, which he has done without producing any injurious consequence. He is now able to walk without the least claudication; and with a freedom of motion, nearly, if not quite equal, to that which he enjoyed before the accident.

Remarks.

This case is important upon several considerations. It shows that a fracture of the neck of the thigh-bone might exist, without being accompanied with eversion or retraction of the limb—it tends to illustrate the doctrine which has been inculcated in a former part of this volume; *viz.* that fractures of the neck of the thigh-bone occur without a sufficient degree of laceration of the investing coverings to allow the fractured ends to overlap; and that such fractures might become converted into nearly the same state as those which, from the first, are attended with the most prominent signs of fracture of this part.

Situation of the fracture.

It might be a question with some surgeons, whether the fracture in this case was within or external to the capsule—a question which I feel myself unable to decide. It has been noticed, that the man was only thirty years of age.

This would lead to the presumption that the fracture was external to the capsule; but, on the other hand, the great retraction of the limb, the absence of ecchymosis, the absence of swelling, except what was confined to the joint, and its immediate vicinity, and the absence of crepitus, would induce one to incline to the opinion, that the fracture was within the joint. Let the situation of the fracture, however, be what it may, it seems to me that the result is particularly deserving of attention. It is a demonstration, that we are now in possession of a plan of treatment, by the judicious management of which, fractures of the neck of the thigh-bone, of a description which allows of retraction to the extent of an inch and a half, might have the fractured parts supported and maintained in such a position, as, sometimes at least, to admit of union, which, if not bony, answers all the purposes of bone—one whose completion is followed by a restoration of the natural strength, freedom of motion, and configuration to a degree which renders the limb nearly, or quite as useful as before the injury was sustained.

Case with laceration.

Mary Richards, æt. 72, was admitted into St. Thomas's Hospital under Mr. Travers, with a fracture of the neck of the left thigh-bone, occasioned by a fall upon the trochanter, in consequence of a slip in walking. The foot was everted and the limb retracted three fourths of an inch ; which was ascertained, by employing the graduated measure, as in the former cases. She felt pain at the upper and inner part of the thigh and behind the trochanter ; and the joint was very tender, so much so, that she could not bear it to be pressed upon. Crepitus could not be felt. She had slight swelling of the upper part of the thigh, and slight apparently superficial ecchymosis in the nates of the injured side. She had not borne upon the limb since the accident, which happened on the day of her admission into the hospital.

On the fourth day, I assisted in placing her upon the fracture-bed, and afterwards superintended the treatment, which was continued for eight weeks. At the end of this time, the limb was examined, and it was found that firm union had taken place without any discoverable shortening of the limb, or other deformity.

This woman, being very feeble and much subject to rheumatism, from which she suffered considerably on the other side, while under treatment, and more or less during her convalescence on both, recovered the use of her limb but slowly.

I saw this woman six months after the accident occurred, and the injured limb still maintained its natural position, and was of the same length as the opposite. She felt no inconvenience in the limb, and she walked in the room with so much equality of power on both sides, that it would be very difficult to say which limb had been injured.

Case with laceration.

Hannah Johnson, æt. 67, was admitted under my care at the Dispensary, having a fracture of the cervix femoris, which had been treated, for five weeks, as a contusion of the hip. Upon inquiry, I found that, five weeks before her application to the Dispensary, she fell off a step and pitched with great violence upon the left side. She was taken up, unable to bear upon the limb—suffering considerable pain at the upper and inner part of the thigh. She was placed, by a medical man, in the horizontal position, which she maintained for a fortnight; and she then, notwithstanding the continuance of the pain, began to sit up daily, by which the pain was considerably increased. When I first saw her, there was a great deal of tumefaction in the whole limb, and the pain in the groin was but little diminished. I was informed there never had been any ecchymosis, and that the swelling, which came on shortly after the accident at the upper part of the limb, was not great. Upon carrying my measure from the superior anterior spinous process of the ilium to the base of the patella, I discovered that the degree of retraction was upwards of three quarters of an inch.* The foot was everted, and there was great pain experienced when pressure was made on the hip-joint. The limb could be readily brought to its proper length, and moved in any direction; but when extension was discontinued, it assumed its former relative position. Crepitus was felt with difficulty.

I recommended this patient to go into St. Thomas's Hospital, where she would have the benefit of one of my fracture-beds. She was admitted under Mr. Travers, who examined the limb—felt the crepitus, and concurred with me as to the nature of the injury.

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* In this, as well as in many other cases, I saw the great importance of adopting this mode of measuring the limb; for the woman having a tilt of the pelvis, arising from curvature of the spine, the *apparent* length of the two limbs might have led to a very erroneous conclusion.

The accident happened on the 28th of February, and she was placed on the fracture-bed on the 5th of April, where she continued for ten weeks, at the expiration of which, the fracture appeared to be united with the limb in its natural position; and, upon measuring it as before, scarcely any difference in the length of the two limbs was perceptible.

When I last saw this woman, she was able to walk without any assistance. She felt no inconvenience in the joint, when she bore upon the limb in walking, or lay upon the injured side. The length and position of the limb continued the same as when she left the hospital.

A woman, æt 45, was brought from the city to St. Thomas's Hospital, where she was admitted under the care of Mr. Travers. Case.

She stated that she tripped as she was walking in the street, and, after staggering for some way, she fell upon the side, so that the trochanter major struck against the curb-stone. She felt great pain in the groin and behind the trochanter immediately after the fall, and was deprived of the power of bearing upon the limb.

Upon examination, a few hours after the occurrence of the injury, the limb was found everted and also shortened one inch, which was ascertained by measuring both limbs with a graduated tape. She had considerable pain and tenderness in the hip-joint and behind the trochanter; which were increased when the limb was moved, especially when the thigh was bent upon the pelvis, and at the same time rotated inward. When the limb was drawn down to its proper length, and the head of the femur fixed, crepitus was felt; but the crepitus was, according to my experience, that which occurs when the fracture is near the head of the bone. There was no swelling, except what took place in the joint and its immediate vicinity, nor was there any ecchymosis perceptible.

It having been fully determined by Mr. Travers, myself, and others, that this was a fracture of the neck of the femur, which, from the degree of retraction that took place, was probably accompanied with considerable laceration of the investing soft parts, Mr. Travers desired that the woman should be subjected to my plan of treatment. She was placed upon one of my fracture-beds on the 11th of August, 1828, the fourth day after the accident, where she remained ten weeks. During this period, the fracture-bed maintained the limb in its proper position and of its natural length.

The limb was now examined, and, as it was thought that the bone was united, the patient was removed from the fracture-bed to one of the common beds of the Hospital, She was kept in bed for a few days, and was then allowed to get up, and, shortly after, to use the limb, with the assistance of crutches.

Both limbs were now of equal length, as far as could be ascertained by the most careful measurement, and the foot was in its natural position. She *walked without limping or other inconvenience; the functions and power of the limb were perfectly restored.*

Remarks.

When we review the history of the two old women's cases, we see sufficient to account for their comparatively tardy recovery. The first and second case that I have related, occurred in men who were in good health at the time of the accident, and whose constitutions were strong and vigorous ; we might, therefore, have expected in them a rapid restoration of the powers of the limb, after the union was accomplished. The third was in a woman who, before the injury, was old, thin, and in delicate health ; and who, after its occurrence, was much afflicted with chronic rheumatism, which greatly increased the debility of her frame. In the fourth case, the slow recovery seems to be fairly attributable to the woman's timidity and to the state of the muscles of the limb ; which had become hard, in consequence of the swelling which had taken place from hanging the limb down and moving it about before she was put upon the fracture-bed.

I cannot say decidedly, whether the fractures in these three females were within, or external to the hip-joint ; or whether they were partly within and partly external. The symptoms which presented themselves would lead me to infer, that the fracture was, in each of these cases, altogether within the capsule, or very nearly so. This point, however, cannot now be determined ; and, therefore, it must suffice, for the present, to say, that the uniting medium is, in all of them strong, and capable of supporting the weight of the body without yielding ; a circumstance from which we might presume, that the fractured ends are joined by the interposition of callus. The five cases are interesting, and seem to me sufficient to shew, that fractures of the neck of the thigh-bone should never be abandoned, before a proper attempt has been made to produce consolidation of the fractured parts.

I have been favoured with the history of the following case by Dr. Clark. It occurred in a lady with whom he is closely allied.

My dear Sir,

Case, in a letter from Dr. Clark, with remarks.

I have much pleasure in answering your enquiries respecting the case of fracture of the neck of thigh-bone now under your plan of treatment.

A thin, delicate lady, 70 years of age, became giddy while standing at the window, and fell on the floor. After the fall, she suffered considerable pain in the groin, and behind the trochanter major, and was unable to bear on the limb. The pain in the groin was greatly increased by rotating and moving the limb ; but, as there was no crepitus perceptible, and as the limb was neither shortened nor everted, the medical gentlemen in attendance believed that the bone was not broken. She was placed in bed in the horizontal position, and leeches and fomentations were applied, with some relief. She was confined to bed for about a fortnight; and then began to sit up daily, more or less, according to her sufferings. The pain continued, and was at times very severe, until you saw her, which was nine weeks after the occurrence of the accident.

The limb was at this time found everted, and also retracted to the extent of an inch, measuring from the anterior superior spinous process of the ilium to the base of the patella. The crepitus of fracture was evident, although not easily discovered. These symptoms and others, joined with the history of the case, led to the conviction, that the neck of the thigh-bone was broken; and it was consequently, agreed in consultation, that your plan of treatment should be tried, as that most likely to benefit the patient.

All the circumstances of the case, from the time that your plan was commenced, are known to you; but you must permit me to state, that I cannot imagine any mode more effectually calculated to keep the limb steadily extended to its natural length, and to maintain the fractured parts in proper apposition, than that which you have adopted. The old lady has now been placed on your fracture-bed nearly six weeks, during which I have been in the daily habit of observing its effects, both on the fractured limb, and on the patient generally. The limb has remained steadily fixed in the position in which you first placed it, with very little pain or uneasiness to the patient at any period; and, for some time past, she has expressed herself perfectly easy in every respect. It is, also, particularly gratifying to me to observe, that while your ingenious and very simple apparatus appears to maintain the fractured parts in proper apposition and at rest, it is admirably calculated to prevent the injurious effects of partial pressure; and to render the different inconveniences and discomforts, which usually attend long confinement to bed in one posture, as little irksome as possible.

After having had an opportunity of observing various methods of treating fractures of the neck of the thigh-bone, in this country and on the

Continent, I have no hesitation in giving yours the preference over every other plan which I have witnessed.

Your patient to day is perfectly easy and well, and I think there is every prospect of her continuing so, as long as you shall find it necessary to keep her in her present position.

I am, dear Sir,
Very faithfully yours,
James Clark.

George-street, Sept. 6th, 1828.

The lady, with whose case Doctor Clark so kindly furnished me, when I was publishing my observations on fractures of the cervix femoris on a former occasion, continued upon the fracture-bed, with the same ease and comfort which she experienced at the early part of the treatment, till the end of the third month, from the time when she was first placed upon it. It was now deemed expedient, by Mr. Travers and myself, to remove her to a common bed, as there was no reason to suppose that union had not taken place. The limb was now of the same length as the other, and we congratulated ourselves upon the prospect of her complete recovery; but, at the expiration of a fortnight, she met with another accident as she was getting into bed, of which we were but partially informed at the time, but which, it afterwards appeared, produced a degree of mischief in the joint, that led us to suppose, a separation of the callus had taken place, not, however, so far as to lacerate the soft parts by which it was surrounded; at all events, the laceration was not sufficient to allow the limb to become retracted for a considerable period after the accident occurred. As we were not aware of the extent of the injury sustained, nothing was done with a view to restore the parts to their former condition. And she is unable to walk without crutches, or some other adventitious support.

Remarks.

I have no reason to doubt that this lady's case was, in the first instance, fracture of the cervix, without laceration; but, as no care was taken to prevent motion and displacement, the close coverings became divided, either by absorption or laceration, or both. The history and symptoms of the case led to the opinion, that the fracture was probably within the capsule. The lady was placed on the fracture-bed in the presence of Dr. Clark, Mr. Travers, and Mr. Earle, who, as well as myself, had previously examined the limb, and had come to the conclusion, that the neck of the bone was broken.

I was favoured with the following case of fracture of the neck of the thigh-bone by Mr. Haines, of Godalming, Surrey. Mr. Travers, who saw the gentleman, is of opinion, that the fracture was external to the capsule, an opinion which appears to me fully justified by the history of the case.

My dear Sir,

Case, with remarks, by Mr. Haines.

In the evening of February 28th, 1828, I was requested to attend Mr. B. æt. 54, whose horse reared and fell back upon Mr. B.'s right hip. I arrived about half an hour after the accident, and found the right limb shortened and immensely swollen, and the knee and foot everted. On the following morning, Mr. Travers visited this gentleman, felt the crepitus without difficulty; and, having perfectly satisfied himself that the injury was a fracture of the cervix femoris, recommended the application of leeches and evaporating lotions, and, also, the employment of your fracture-bed.

Mr. B. was placed on the fracture-bed on the sixth day, where he lay ten weeks perfectly quiet. In the twelfth week he was able to get down stairs without assistance; and, in the sixteenth, did duty at his own church, after walking near one-third of a mile up hill.

I have this day seen him, and I am happy to say, that he is now capable of walking for two hours in complete ease. He expresses a lively recollection of the perfect comfort felt during his long confinement on the fracture-bed.

After he was placed upon it, so easy was his state, that all medical treatment was abandoned.

Your's, truly,

George C. Haines.

Godalming, Sept. 5, 1828.

My observations upon recent fractures of the neck of the thigh-bone, and the experience with which I have been favoured, incline me to draw the following conclusions.

Inferences drawn from the preceding observations and cases.

1st. That fractures of the cervix femoris within the capsule, unattended with laceration of the close coverings, will unite by the intervention of callus, if apposition, pressure, and rest, be maintained; but, perhaps, the process of union will not generally be so rapidly completed as when the fracture is in the middle of the bone.

2d. That fractures of the cervix femoris within the capsule, attended with a division of the investing membranes, might, under proper treatment, probably arrive, in many instances, in the course of a short time after the accident, at a state nearly as favourable for the accomplishment of osseous union, as those in which these coverings remain nearly or quite entire; but it is likely that the union will be more or less rapid, according to the degree of injury sustained by the periosteum and reflected membrane.

3d. That we cannot insure accurate co-aptation of the fractured surfaces; and, consequently, if it should be found that union by bone can generally be effected within the capsule, we might expect the consolidation to be now and then followed by considerable inconvenience in the joint, for some time after its completion; but this will only occur when the irregularity is in the anterior part of the cervix, where the tendon of the psoas magnus and iliacus internus would press the front of the capsule against the projecting edges of the bone.

4th. That though I have never yet failed to benefit the patient in any case of recent fracture of the neck of the thigh-bone, whatever might turn out to be the bond of union; yet I think, in the present state of our knowledge upon this subject, it behoves us to give a guarded prognosis. I see, however, no sufficient reason to induce me to believe, that fractures of the neck of the thigh-bone, within the capsule, might not generally be united by bone; and if osseous union be produced, it appears to me, that it ought to take place without any retraction or eversion of the limb which would be deserving of notice, whether the cervix be broken within or external to the capsule; except, perhaps, in those very rare cases where the fracture is comminuted, and, at the same time, complete.

5th. That the practice I have recommended might be resorted to with perfect safety—that it is not likely that anchylosis of the joint, or a superabundance of callus, will occur where union takes place by bone, so as to impede, in any considerable degree, the act of progression—that there is no danger whatever of sloughing of the soft parts, or other injury, from partial pressure, where the treatment I have advised is properly conducted ; and that this treatment might be followed, not only with safety, but with a degree of ease and comfort to the patient, which, as far as I know, cannot be obtained by any other means hitherto introduced.

Sec. 10.—*Treatment of Fractures of the Trochanter Major.*

Inadequacy of of the usual means.

It is advisable, in the management of fractures of the trochanter major above the neck, to keep the pelvis and the limb at rest in the same relative position. I do not know any means, commonly resorted to, by which this can be accomplished. It cannot be done by the common short splints, because they do not effect the pelvis in any way, nor have they any influence upon the upper portion of the bone. It cannot be done by the double-inclined plane, because the pelvis must always be moved when the patient uses the bed-pan—it cannot be done by Desault's or Boyer's splints, because they, also, allow the pelvis to move independently of the limb.

The treatment principally mechanical.

The treatment of fractures of the trochanter above the cervix, as well as of all other fractures, is principally mechanical. When the patient is in good health, no constitutional treatment is necessary, except with a view to act upon the bowels as occasion may require. Topical applications should be employed, in order to reduce the active inflammation which comes on after the accident; but these will rarely be required after the first three or four days.

Treatment when above the cervix.

In the mechanical management of these cases, according to the plan which I recommend, the patient should be placed on the fracture-bed, prepared in the same manner as for fractures of the neck of the bone, but with the planes fixed so as to form more obtuse angles. The patient is thus secured in the most comfortable posture, and the pelvis and the limb are kept in a state of quietude. Care should be taken to support the limb in a proper position; which is with the ball of the great toe and the patella in a line with the superior anterior spinous process of the ilium. In these fractures, there can be no shortening of the limb, unless the fracture of the trochanter, of which I am now speaking, is accompanied with fracture of the cervix; therefore, where the fracture is entirely above the cervix, there will be no occasion for extension. The trochanter should be supported by means of a pad placed between the mattress and the limb, and the action of the glutei muscles resisted by a bandage, applied so as to keep the fractured surfaces in close apposition, and a splint should be placed along the outer side of the limb, in order to maintain the trochanter and the shaft of the bone in their natural relative position. This splint should be secured in the same manner as when the fracture is in the cervix.

Below the cervix.

When the fracture is at the lower part of the trochanter major below the cervix, retraction of the limb might take place; and when this happens, it should be extended and kept of its proper length by the operation of the fracture-bed. With the exception of the bandage, which may be omitted, the treatment of fractures in this situation does not differ from that which has been advised for fractures of the trochanter above the neck.

When attended with fracture of the cervix.

If the fracture of the trochanter be complicated with fracture of the cervix, retraction of the limb generally takes place; and the treatment required will be, for the most part, the same as that which is proper for fractures of the trochanter below the neck, when the broken portions overlap; but, in these cases, the surgeon should take care not to make much pressure on the outer side of the limb by the splint, as he might, by so doing, force the fractured parts into unnatural positions, and thus produce deformity.

Objections to the usual means.

The objections which have been urged against the use of the common contrivances in the treatment of fractures of the neck of the femur, also, militate against them, when they are had recourse to, in the management of fractures of the trochanter below the neck, or in fracture of the trochanter complicated with fracture of the cervix; and, therefore, in my opinion, they ought never to be employed, in such cases.

Sec. 11.—*The usual Modes of treating Fractures of the Femur just below the Trochanter Minor.*

The common opinion respecting these fractures.

This situation has been regarded as one of the worst in which a fracture of the thigh can occur; not that there is any thing, in reality, peculiar in the fracture itself, regarded merely as a fracture, but surgeons, having found the common means inadequate to prevent deformity, have conceived, it would seem, something very formidable in the fracture itself; and have been prone to refer the cause of deformity, which so often follows these accidents, to the nature of the injury, rather than to any fault in the means which they have employed for its cure.

Displacement of the fractured ends.

When a loose fracture occurs in this part of the femur, the upper portion is commonly bent upon the pelvis, so as to form an angle with the lower portion, projecting forward at the seat of fracture. The upper portion being forced into the bent position, principally by the action of the iliacus internus and psoas magnus, pricks and lacerates the extensor muscles of the leg, while the ragged end of the lower portion is forced against the flexors. The transverse displacement having been effected, the fractured extremities of the bone goad the flexor and extensor muscles of the leg; which are thus excited to act most powerfully upon the lower portion of the bone, so as to draw it up beneath the upper portion, and produce a degree of shortening of the limb, varying from one inch to seven or eight, *(see Plate* V. *Fig*. 1.*)* Displacement first occurs in the transverse direction of the bone, and then in the longitudinal. These two varieties of displacement follow one another in all cases; and commonly produce that compound variety which I call transverse, longitudinal and angular, when the fracture is transverse, or runs through the bone downward and forward, downward and inward, or downward and outward, and is attended with much laceration of the soft parts. But it should be remarked, that when the fracture takes a direction downward and backward, which, however, very rarely happens, the principal displacement which occurs is in the direction of the long axis of the bone, *(see Plate* V. *Fig.* 2.*)* In these cases, the upper portion lies behind the lower; and hence those muscles which have the greatest influence in producing transverse displacement when the bone is broken in any other direction, have the effect of drawing the fractured surfaces together, provided that the natural length of the limb be preserved; and, consequently, we find, that fractures which divide the bone downward and backward are, from this circumstance alone, the most favourable to treat.

The cause of the difficulty experienced in treating these fractures.

It has been supposed, that the main difficulty which surgeons have to contend with, is the contraction of the flexor muscles of the thigh, which they have not been able to control; but the command of these muscles is only one indication out of seven that I shall mention.

Indications.

In these cases, there are seven indications to fulfil—1st. The pelvis should be fixed, for the upper portion here, as in fractures of the cervix, or of the trochanter major, follows the motions of the pelvis; therefore, unless this part be fixed, we have no certain means of fixing the upper portion of the bone in the position in which we ought to place it. 2d. The thigh should be raised so as to form an angle with the pelvis; so that the lower portion of the fractured bone shall be brought into a natural line with the pelvic portion. 3d. Extension must be kept up, so that the fractured ends may be prevented from overlapping. 4th. Inversion and eversion of the foot must be prevented. 5th. The fractured surfaces should be placed in close apposition. 6th. The fractured ends should be prevented from moving upon each other. 7th. The fractured ends should be supported, so as to guard against any displacement which might otherwise arise from the accidental action of the muscles of the limb.

Do the usual plans of treat-

The question now for consideration is—how far the mechanical contrivances usually had recourse to in the management of these accidents answer the indications that have been pointed out?

ment answer these indications?

I have seen the short thigh-splints employed with a view to secure the broken ends of the bone, when the fracture is in this situation, the limb being, at the same time, raised, by placing a pillow under the knee. It must be evident, however, to the thinking surgeon, that these splints can have no power whatever in steadying the pelvis; it must be also clear, that their operation is not calculated to keep up extension. The pillow placed under the knee, is not of a nature to keep the lower part of the thigh at a proper and unvarying angle with the upper; these splints do not prevent inversion or eversion of the foot; they have but little influence in preventing the displacement of the fractured ends, which may arise from the accidental contraction of the muscles inserted into the bone.

Short thigh-splints.

What, then, does the surgeon gain by the adoption of this plan? It seems to me, he may almost as well leave the case to Nature, as attempt to secure the fractured ends by splints,

Inference.

so little calculated to produce the desired effect. I have seen the limb become shortened *nearly eight inches* under their use, in a case of fracture a little below the trochanter minor; and otherwise terribly deformed. The degree of success which the surgeon gains, he must refer to his own skill and ingenuity, in contriving other means to assist in keeping the parts in any thing like tolerable apposition.

The double inclined plane or fracture-box.

The double-inclined plane, and the common fracture-box, are much resorted to in the treatment of these cases. When either of these contrivances is used, the patient is placed on his back upon a mattress; his shoulders are raised by means of pillows, and the injured limb is laid over the planes of the apparatus, elevated, so that the lower portion of the broken bone may be brought up in such a manner as to form a natural line with the pelvic portion.

Intention.

This position of the limb and of the body is recommended with a very good intention, viz. to relax the psoas magnus and iliacus internus, which are the principal muscles that bend the pelvic portion of the bone, upon the pelvis. But those who follow this mode of treatment must overlook other important indications—

they cannot have noticed that the inclined position of the body indirectly increases the degree of deformity which supervenes, when either of these apparatuses is employed. This, however, I think will immediately appear: the tendency of the body to slide towards the foot of the bed will, of course, be greater when it is placed upon a plane inclining in that direction, than it would if it were lying upon a horizontal plane. What, then, must be the consequence of placing the trunk in this position? We have almost daily demonstration, that the body, gravitating towards the foot of the bed, forces before it the pelvic portion of the fractured femur, while the apparatus, and all that part of the limb below the fracture, continue as they were first placed, or nearly so. The apparatus does not slide towards the foot of the bed in the same proportion as the body; and, consequently, that part of the limb which is situated below the fracture will remain comparatively quiet, being little influenced by the gravitation of the body, or by the various movements which take place in that part of the fractured bone which is attached to the pelvis. Now it must be obvious, if the body slide towards the foot of the bed, and the apparatus remain nearly at rest, that the upper and back part of the thigh will be forced against the upper end of the apparatus; pressure will be in this way occasioned at this part of the thigh; which will be increased, in some measure, by the sinking of the nates into the bed. This observation will be illustrated by referring to the diagram, *(Fig. f)* where a portion of the frame of the double-inclined plane, and of the side of the mattress, are supposed to have been removed, in order to shew the sinking of the nates more effectually, and also the pressure of the apparatus against the back of the thigh, in consequence of this, and the gravitation of the body towards the foot of the bed. The pressure of the apparatus in this situation is sometimes so great as to produce considerable pain; but its most injurious consequence is, that of assisting the iliacus internus and psoas magnus in bending the upper portion of the bone upon the pelvis. Hence it will be seen, that the very plan which is adopted to relax the flexor muscles of the thigh, has no trifling influence in bringing about the horrible deformity which we have so frequently to witness.

Manner in which retraction takes place.

When the short splints are used alone, the shortening of the limb is occasioned partly by the action of the long flexors and the extensors

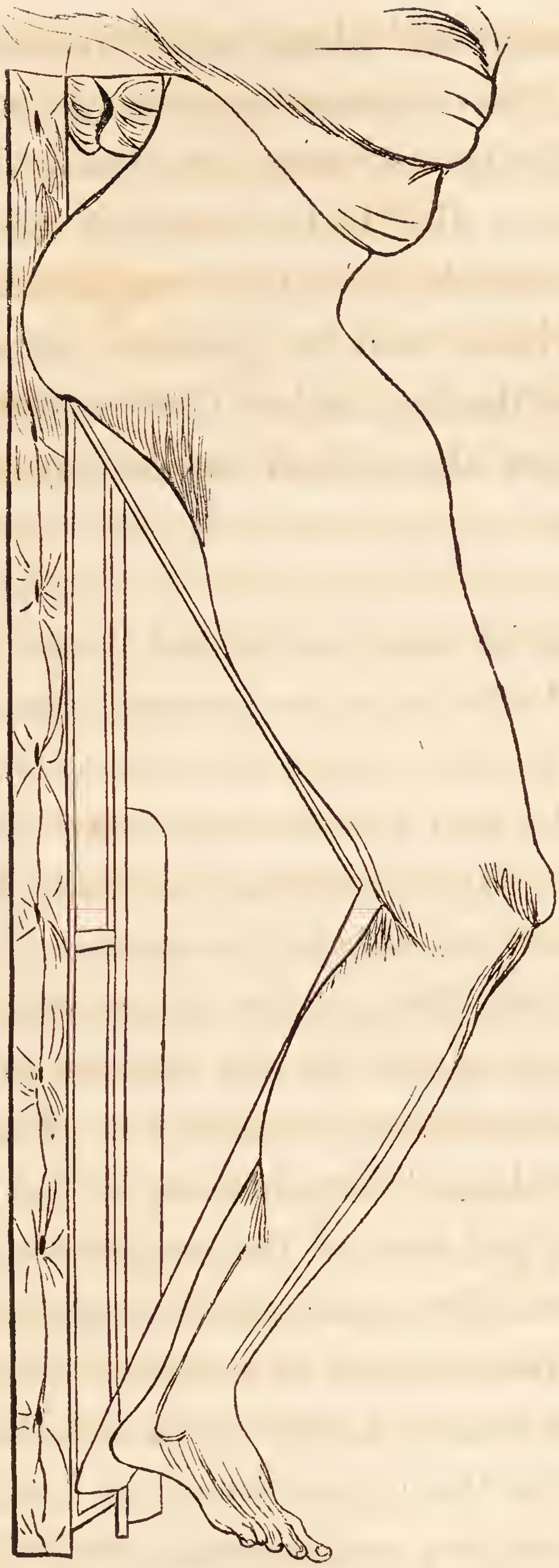

Fig. f

of the leg, and partly by the gravitation of the body towards the foot of the bed; but when the double-inclined plane, or the fracture-box is employed, the unnatural approximation of the knee and the pelvis, arises principally from the gravitation of the body; for, the mechanical resistance which the apparatus offers to the muscles which tend to produce retraction of that part of the limb below the fracture is such, as to prevent them from having any considerable effect.

Elongation of the thigh-plane.

It might be said, that if the thigh-plane be elongated sufficiently for the upper end of the apparatus to bear upon the tuberosity of the ischium, the evil I have mentioned would be prevented. My experience, however, does not enable me to coincide in this opinion. I have observed that, though the upper end of the apparatus be placed in the manner here supposed, it does not long remain so. The reason of this is evident. The tuberosity of the ischium and the upper end of the apparatus are not preserved in the same relative position—the nates sink into the bed or mattress upon which the patient lies, as I have said; but this is not the case with the apparatus or, at least, in the same proportion; consequently, the tuberosity of the ischium gravitates away from the upper end of the apparatus, which thus produces the effect which I have just described. Transverse displacement, then, of the upper portion of the bone is produced, partly by the action of the muscles, and partly by the pressure of the apparatus ; and, when it has taken place, the limb becomes shortened more or less ; on some occasions, the degree of retraction is very great. I have seen it to the extent of *seven inches* in a case of fracture of the upper third of the femur, where the fracture-box was employed ; and that, too, under the superintendence of one of the most able surgeons in this town.

Inference.

The fracture-box answers two of the indications which I have pointed out—it supports the limb in the bent position, and prevents inversion or eversion of the foot, but it does not fix the pelvis ; it does not maintain a proper degree of extension ; it does not steady the upper portion of the bone ; it does not keep the fractured surfaces in close apposition ; nor does it prevent them from becoming displaced.

Observations.

From what has been said, it might be perceived that, neither the double-inclined plane, nor the fracture-box, is calculated to enable the surgeon to bring these accidents to favourable terminations ; and, consequently, we must expect to have deformity of the limb when either of them is employed, if the fracture be attended with a sufficient degree of laceration of the surrounding parts, to allow the broken extremities to become displaced.

Desault's and Boyer's plans.

Another plan of treating fractures at this part of the femur, consists in placing the limb in the straight position, and keeping up extension by the use of Desault's splint, or that contrived by Boyer. When Boyer's splint is employed, the extension is regulated by the screw, which is placed at the lower end, in the same manner as when the fracture is in the neck of the bone. The extending power of this splint is very great; and, if we had nothing to do but keep up extension, I cannot conceive any thing better calculated to answer this purpose. But the propriety of maintaining the limb of its natural length is only one indication out of seven that I have mentioned ; and this can, unfortunately, only be fulfilled, with this contrivance, when the limb is placed in the straight position—a position which is not likely to be followed by favourable results. In the treatment of these cases, the thigh should be bent upon the pelvis, in order to relax the psoas magnus and iliacus internus, and to bring the lower fragment in a natural line with the upper. This cannot be done with Boyer's apparatus; for this apparatus requires the limb to be placed on a horizontal plane, or nearly so. If it were placed so that the limb may lie on a plane inclining towards the body, the strap which crosses the upper part of the thigh obliquely, would operate so as to assist the muscles in bending the upper portion of the bone upon the pelvis—an effect which is not so likely to happen when the limb is placed in the straight position. It might be argued, that we might depress the upper portion of the bone, so as to bring it to a natural line with the lower, by the application of a splint to the front of the limb; and thus, not only overcome the flexor muscles of the thigh, when the limb is in the horizontal posture, but also the effect produced by the strap, affixed to the upper end of the apparatus, when the thigh is bent upon the pelvis. This cannot be denied; but, what is to be apprehended from this mode of procedure? I scarcely need observe, that ulceration of the soft parts which cover the broken end of the upper portion of the bone, would be likely to occur; consequently, according to my judgement, this method of meeting the evil, arising from the action of the muscles simply, or from the combined influence of the muscles and the apparatus, ought not to be advised.

Inference.

This apparatus has the effect of keeping the foot in a proper position, and it might also keep up extension, but rarely with impunity; for the pressure of the strap fastened to the upper end of the apparatus, forces the pelvic portion of the bone outward, and thus occasions deformity; even when the fracture is not accompanied with any considerable laceration of the parts which surround the bone in the situation of the injury. There are five indications which, it appears to me, this apparatus does not fulfil, and therefore I think I shall not be going too far when I state that, in my opinion, it is not a contrivance upon which, in the management of these cases, the profession can depend; its construction is such as to render it inefficient in the hands of the best surgeons.

Remarks.

If I am right in my conclusions, it will be no longer a matter of surprise that we see so many instances of deformity after fractures of this part of the femur. The causes of the deformity are evident; and, in my opinion, if they be not surmounted, in all ordinary cases, whether the fracture be transverse or oblique, the surgeon is to blame.

Sec. 12.—*The Author's Mode of treating Fractures of Femur just below the Trochanter Minor.*

Fractures in this situation admit of being treated without deformity.

I shall now proceed to describe a plan of treatment for fractures of the femur just below the trochanter minor, by which all those evils which I have mentioned might be avoided; and by which these fractures might be united with as much facility as fractures at any other part of the upper or lower extremity; and without the occurrence of shortening or deformity of any kind.

The author's mode of treating these cases.

The fracture-bed which I have recommended to be used in the treatment of fractures of the neck of the thigh-bone, and in the treatment of fractures of the trochanter, will also be found the best for those which occur just below the trochanter minor. When it is employed for these accidents, however, it is proper to fix the planes at more acute angles, in order to relax the iliacus internus and psoas magnus in a greater degree than is required for fractures of the cervix. The surgeon, having placed the patient upon the bed, should apply a roller neatly upon the foot and leg; and then extend the thigh and secure the foot in the same manner as for fractures of the cervix. While the surgeon is doing this, an assistant should prevent the pelvis from being drawn up upon the middle, or thigh-plane, from the angle which is destined to receive it. The assistant continuing to fix the pelvis, the surgeon should place a pad between the back of the thigh and the mattress, wide enough for the thigh to rest upon, and then apply three splints to the thigh; one on the inner side of sufficient length to reach from the pelvis to the lower part of the inner condyle of the femur, another to reach from the superior anterior spinous process of the ilium to the base of the patella, and the third from the upper part of the trochanter major to the lower part of the outer condyle. These splints, which ought to be well made, should be neatly padded and confined to the thigh by three circular straps, passed round the limb, under the pad upon which it lies, and over the splints, so as to confine them to the limb. The pelvis should now be secured by buckling the pelvis-strap; which should pass over the upper ends of the outer and front splints, but not so as to make the latter press uncomfortably upon the superior anterior spinous process of the ilium. If the fracture be very oblique, care should be taken to pad the splints, so that they might press the fractured surfaces together.

Indications answered.

When a fracture in this situation is thus secured, and the treatment properly managed, the seven indications I have mentioned are completely fulfilled, and the surgeon might feel himself morally certain, that union will take place without any shortening of the limb, or any perceptible deformity; unless there be great comminution of bone, as generally happens when the fracture is occasioned by a musket-ball, or when exfoliation occurs; in such cases, a guarded prognosis should be given; but he should recollect, that *neither the obliquity of a fracture at this part, nor the action of the muscles of the injured limb,* will any longer be considered an excuse for ignorance or inattention.

Time required for consolidation.

Fractures of the upper third of the thigh-bone, external to the capsule, require the patient to be confined from a month to six weeks; in order that the bone might become firmly consolidated, and capable of bearing the weight of the body without yielding. If the patient is allowed to bear upon the limb before the callus has become strong, he is in danger of producing shortening of the limb, or a bend in the bone in the situation of the fracture, which cannot afterwards be remedied.*

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* I will here relate a case which tends to illustrate this observation; and, also, to shew the advantage derivable from the use of the fracture-bed, before consolidation is completed, in cases of fracture of the thigh, where deformity has taken place under any of the ordinary modes of treatment.

Case. John Gardener, æt. 28, was admitted into St. Thomas's Hospital on the 23d of June, 1828, under Mr. Green, with an oblique fracture of the femur, situated at the lower part of the middle third. The fracture extended through the bone downward and outward, and was occasioned, on the 24th of May, by a cask of beef, which fell upon the thigh. He had short splints applied, and the limb placed in the straight position, with the feet tied together.

At the time of his admission into the Hospital, the lower portion of the bone was *retracted to the extent of two inches and a half.* There was a great deal of swelling of the limb, and strong adhesions had taken place. *Twenty-seven days after the accident,* he was placed upon the fracture-bed, and the limb extended to its natural length; which was done with facility, over the planes of the fracture-bed, though it could be elongated very little by the hands. Before he was placed upon the fracture-bed, Mr. Bean, a very intelligent and attentive dresser, who had the management of the case, endeavoured, in my presence, to diminish the degree of retraction

The plan recommended considered to be the best, though not indispensible.

I might here observe, that the treatment which I have advised for fractures of the thigh, a little below the trochanter minor, is the best that I am acquainted with; but, before the introduction of the fracture-bed, I was in the habit of using, in these accidents, the apparatus which I employ in the management of simple and compound fractures of the leg, &c. I think, however, that this apparatus cannot hold the upper portion of the bone sufficiently, in all cases, to render it secure from a degree of motion, which might be injurious, when the patient raises the lower part of the body to answer the calls of nature; and, as there is no

by manual force; but he found himself incapable of doing so more than about half an inch. As the man lay upon the fracture-bed, splints were applied to the thigh, to steady the fractured ends, and to press them together. This treatment was continued for *twenty-five days,* at the expiration of which, the limb was examined, and it was found that the bone was united with the *limb of its natural length and the foot in its proper position.*

This man felt his limb so strong that he began to bear upon it in a few days after he was removed from the fracture-bed; and the consequence is, that the limb has become shortened rather more than a quarter of an inch. In cases of oblique fracture, I do not think it prudent to allow a patient to bear upon the limb for ten days or a fortnight after the union appears to be quite firm.

advantage gained by it which is not equally well, and even better obtained, in such cases, by the use of the fracture-bed, I am induced to recommend the employment of the latter, as that upon which the surgeon can best depend; though, as might be seen by the following cases, the apparatus is much superior in its effects, even when the fracture is at this part of the bone, to any of the ordinary means; and might, therefore, be applied when the bed cannot be procured.

Case.

A man, aged 51, fell over a tub and broke his thigh-bone obliquely, from one inch and a half to two inches below the trochanter minor. He was admitted into Guy's Hospital under the care of Mr. Foster. The limb was first placed in the straight position, and confined by means of a long splint; it was afterwards put upon the double-inclined plane, the shoulders being raised at the same time, so as to relax the psoas magnus and iliacus internus: but he suffered greatly from these modes of treatment, and, as they failed to keep the bones in any thing like tolerable apposition, they were discontinued.

On the tenth day, as the limb lay upon the double-inclined plane, the fractured ends overlapped, so as to make the *fractured limb nearly three inches shorter* than the sound one; and there was, also, an angle formed at the seat of fracture, which might be represented by the elbow, when the arm is half bent.

I now assisted Mr. Foster's dresser, Mr. Mash, who is now a well-informed and zealous practitioner, in applying my apparatus, which was worn for a month. At the end of this time, the limb was examined, and the bone was found firmly united. The limb which had been fractured was now *of the same length as the other, and there was not the least apparent deformity in any way.*

His bed was made two days after the apparatus was applied, and this was repeated at the end of a fortnight. The limb could be rolled upon the pelvis without giving him pain; and, apparently without disturbing the fracture. He could draw himself up in bed, without experiencing any sensation of motion or of displacement in the injured part.

This poor fellow often expressed himself most strongly in favour of the comparative ease and comfort of the treatment which was last adopted. He rapidly recovered the perfect use of his limb.

The following case I was favoured with by Mr. Joy, and I prefer relating it here to any other, in consequence of its having occurred in the practice of a surgeon, with whom I have not the pleasure to be acquainted, except by name.

Northwald, 18*th*. *Aug*. 1828.

Dear Sir,

A communication from Mr. Joy, with a case.

I send you the particulars of a case of a fracture of the upper third of the thigh-bone, which occurred in an old lady, in her 74th year.

In the evening of Sunday, 6th of April, of the present year, I was summoned to attend upon an old lady, who had met with a serious injury, in consequence of being pushed down by some boys. On my arrival, she complained of great pain in the left thigh and hip; and, upon turning the bed-clothes off the affected side, an immense tumour presented itself at the upper part of the thigh, which I found to be the result of a transverse fracture of the femur, immediately below the trochanter minor. *The limb was shortened an inch and a half, and the foot was turned inward.*

Having placed the limb in as easy a position as circumstances would admit, and ordered a spirit lotion to be applied frequently over the fracture, I left for the night.

Upon visiting my patient the next morning, I had the honour to meet Sir Richard Sutton, (a gentleman whose name is proverbial in the cause of humanity) who very politely offered me the use of the apparatus which you employed in his own case of non-union. This I found to be that which you, in your Syllabus, recommend to be adopted, in cases of simple fracture of the middle and lower thirds of the thigh-bone, &c. It, however, appeared to me to be constructed in such a manner, as to admit of being used with more advantage in cases like the present, than any of the common contrivances. I determined, therefore, upon giving it a trial. The patient was placed on a mattress; and, when the apparatus was properly adjusted, she expressed herself as being, comparatively speaking, in Heaven. Nothing worthy of remark occurred during her six weeks' confinement, at the end of which the apparatus was removed; and it was now particularly gratifying to observe, that the means employed had produced a most perfect limb, *having neither deformity nor shortening;* nor did moving it in any direction cause the least uneasiness. Thus far, and *as far as your apparatus was concerned,* were our wishes accomplished, and the patient truly grateful for the benefit she had received.

The following evening I was sent for in great haste, as the old lady was supposed to be dying. I found her insensible, bedewed with a cold sweat, and with a pulse imperceptible. I succeeded in getting her to swallow some brandy and water, which was repeated at intervals, until re-action took place; and I resorted to such other means as the circumstances of the case seemed to indicate, and she was better on the second day; but, after this, she rapidly sunk, and died on the fourth day.

Having obtained permission of the family to examine the limb, I cut down to the seat of fracture, which I found had passed through the bone, about a third of an inch below the trochanter minor; but the fractured ends were now *evenly and firmly united.* In dividing the soft parts, I observed an abscess, situated between the pectinalis and obturator externus muscles, which contained about an ounce of unhealthy pus, but which had *no communication with the fracture.* The irritation occasioned by this abscess was very likely to be the cause of death, in a person so far advanced in years.

Dear Sir,
Yours respectfully,
W. Joy.

These cases are sufficient to shew that this apparatus, though inferior to the fracture-bed, in the management of fractures of this part of the bone, is more beneficial than any of the common contrivances. The only objection I have to its being used, in the treatment of simple fractures of the femur, just below the trochanter minor, arises, as I have said, from the fear that it might not, in all cases, secure the upper portion of the bone from a degree of motion, which might retard the uniting process.

CHAP. IV.

SIMPLE FRACTURES OF THE MIDDLE AND LOWER THIRDS OF THE THIGH-BONE.

SEC. 1.—*Causes, Symptoms, and Nature, of Simple Fractures of the Middle and Lower Thirds of the Thigh-Bone—Displacement—Its Causes and Consequences.*

Most frequent.

FRACTURES of the femur occur more frequently in the middle-third than in any other part. This probably depends, in a great measure, upon the size of the bone, which is smaller here than at the upper or lower third.

Period in which they occur—causes.

Fractures in this situation are common at all periods of life, and are produced by blows, falls, the passage of laden carriages over the limb, &c.

Easily discovered—unerring signs.

All fractures in this part of the bone when complete, are easily discovered; sometimes even from the manner in which the limb lies upon the bed, there being frequently an angle formed at the seat of fracture, projecting in one direction or another. If the nature of the injury should not be evident at the first view, it may be easily ascertained by fixing the upper portion of the bone and, at the same time, attempting to move the lower in different directions. This will give rise to preternatural motion if a fracture exists, and also, in complete fractures, crepitus, when the broken ends are in apposition. To these symptoms might be added, the patient's inability to raise the limb. These symptoms are sufficient to enable the surgeon to distinguish a fracture of the thigh-bone at this part from any other injury.

Nature of the fracture.

The existence of a fracture having been made out, the surgeon should endeavour to ascertain the direction which it takes through the bone. This will lead to modifications in the treatment by which the result of the case will be greatly influenced.

Transverse without laceration.

Fractures of the thigh are occasionally transverse. This fracture is not commonly accompanied with much laceration of the soft parts, and hence it happens, that the fractured ends are seldom entirely separated from one another.

If the fractured ends do not overlap, we may, according to my experience, at once conclude that the fracture is transverse; and if they are not easily moved in the transverse direction, we may infer that the soft parts are but little torn. This variety, which might be called a transverse fracture of the femur without laceration, is very easily managed. It is probably this variety which has given rise to so much boasting on the part of those surgeons who have hastily come to the conclusion, that fractures of the thigh may be treated by position alone.

With laceration.

Transverse fractures of the femur are, however, sometimes accompanied with a great deal of laceration of the contiguous textures, so that the fractured ends may be easily separated from one another in the transverse direction, and when this has taken place, they readily overlap, though rarely in a great degree. This fracture might be termed a transverse fracture of the femur with laceration. It is for the most part easily distinguished from any other, by the great projection of the broken ends when they are riding, and the facility of maintaining the limb of its proper length when the fractured surfaces are brought together. This variety also admits of being managed without difficulty.

Oblique.

Fractures of the femur are generally more or less oblique. I have not observed, however, that oblique fractures pass through the bone more in one direction than in another. Fractures which I rank under this *head,* are always, as far as I have noticed, attended with retraction, but if the obliquity is not great, and the laceration trifling, the retraction is for some days inconsiderable. The degree of retraction in oblique fractures, is commonly proportionate to the degree of laceration of the soft parts which surround the bone at the seat of fracture. Hence it will be seen that, when the internal laceration is great, the retraction of the lower portion of the limb may take place to a frightful extent. Oblique fractures, may therefore, in my opinion, be also very properly divided into two varieties, dependent upon the condition of the soft parts. The first might be called fractures without any considerable laceration, and the second, fractures with extensive laceration of the surrounding structures.

Without laceration.

With laceration.

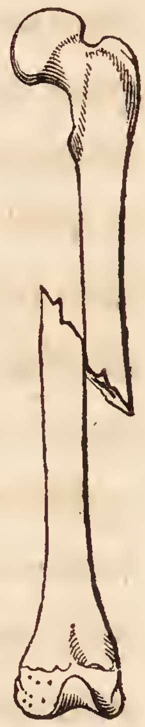
Direction.

The surgeon, having made out the nature of the fracture so far, should proceed to discover the direction in which the bone is divided. This is a matter of very great importance; for upon the accuracy of his knowledge of this circumstance, will depend much nice modification in the treatment, and consequently, the proper apposition and rapid re-union of the fractured ends. This might generally be ascertained by considering the direction in which the broken extremities are displaced.

Downward and outward.

When the fracture divides the bone obliquely downward and outward (*Fig. a*), the broken end of the upper portion is found on the outer side of the lower, while that of the lower portion is displaced towards the inner side of the upper. The surgeon might easily discover this variety of displacement by passing his finger firmly along the outer side of the limb. If the finger is carried from the great trochanter towards the condyles, the surgeon finds that, when it reaches the lower end of the upper portion, it slips suddenly over it; and at this part the keen edge of the upper portion will be felt projecting at the outer side more or less, according to the extent of displacement. In such cases the fractured end of the lower portion which lies on the inner side of the upper, cannot always be felt through the muscles.

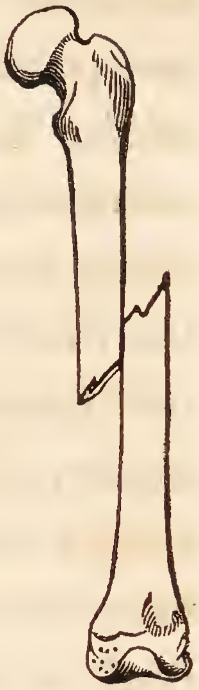
Fig. a.



Downward and inward.

When the bone is broken obliquely downward and inward *(Fig. b)*, the lower portion will be found projecting on the outer side of the upper. In such a case, the finger, carried as I have mentioned from the trochanter to the condyles, would not pass suddenly over the broken end of the upper portion, but would strike against the fractured end, or some other part of the lower portion. This position of the fractured ends will usually be found sufficiently diagnostic of the direction of the fracture, the signs of the transverse fracture being absent.

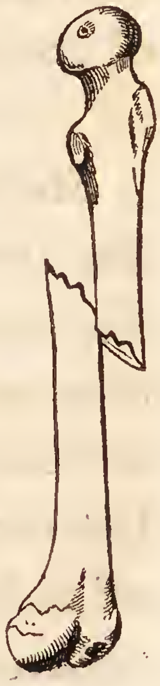
Fig. b.



Downward and forward.

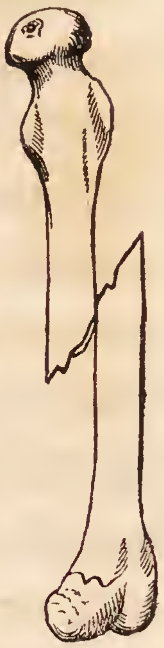
When the fracture runs downward and forward *(Fig. c)* instead of to the inner or outer side, the displacement is different. In this variety the edge or point of the upper portion is felt projecting anteriorly, while the fractured end of the lower portion lies behind.

Fig. c.



Downward and backward.

In fractures downward and backward *(Fig. d)* the situation of the fractured ends is reversed; that of the upper portion being found projecting posteriorly, Fig. d.



while that of the lower is easily felt before it. These differences in the relative position of the broken extremities of the bone are readily distinguished, commonly by passing the finger firmly along the front of the thigh. When the fracture is downward and forward, the finger, on arriving at the seat of injury, slips suddenly over the fractured end of the upper portion ; and, in fractures downward and backward, it strikes suddenly against that of the lower portion.

Sometimes the direction of the fracture partakes more or less of two of those which have been mentioned ; but, after what has been said, I think the intelligent surgeon will rarely meet with any difficulty in making out the direction of any fracture which he may have to examine.

Fractures of the lower third—nature.

Fractures of the lower third of the femur, like those of the middle, occur at all periods of life, and are produced by similar causes. The bone might be broken at this part transversely, or it might be broken obliquely in any direction. Occasionally only one of the condyles is broken off obliquely, ocasionally both are broken off transversely or obliquely, and at the same time split asunder. The degree of injury which the soft parts sustain is sometimes inconsiderable and sometimes very great, so that the fractures which occur in the lower part of the femur, like all others, might be divided into those which are not accompanied with any considerable laceration of the surrounding textures, and into those which are attended with great laceration of these textures. The latter might also be called loose fractures, for when the soft parts surrounding the bone at the seat of fracture are much torn, the broken ends admit of great extent of motion.

Symptoms.

The symptoms of fracture just above the condyles are in general the same as those which are observed when the injury takes place in the middle of the bone, and the indications which lead to a knowledge of the direction of the fracture are also for the most part similar.

When one of the condyles is split off.

When one of the condyles is split off, the fracture might be easily ascertained by placing the limb in the straight position, and fixing the femur while the leg is moved laterally. If a fracture exists of this description, a lateral hinge-like motion will be discovered in the knee-joint, and also a distinct movement of the fractured condyle, accompanied with crepitus, when the fractured surfaces are pressed together. The tumefaction of the knee-joint is sometimes very great. It is necessary to connect this assemblage of symptoms, in order to distinguish this accident from others which occur in the other bones which enter into the composition of the knee-joint.

Displacement.

The degree of displacement which is observed in fractures of the lower third of the femur, differs in some respects from that which takes place in those which are situated in the middle of the bone, and is sometimes attended with much more serious consequences. This difference appears to me to be referable to natural causes, which I shall now attempt to explain.

Physical causes of the various kinds of displacement in fractures of the middle and in the lower third.

The only physical cause of displacement inherent in the limb, which is observed in fractures of the thigh, must be referred to the action of the muscles; and those which are attached to the fractured portions of the bone, are the principal that tend to separate the fragments in the transverse direction. We will consider the natural action of those which are more particularly concerned in separating the fractured ends from one another, when the fracture is situated near the extremities of the bone.

Flexors of the thigh.

The natural action of the psoas magnus and iliacus internus is to bend the thigh upon the pelvis. The power of these muscles is so great that they lift the greater part of the weight of the entire limb with the greatest facility. Now, as these muscles do so much in bending the whole limb upon the body, we might infer that they would do their part in raising half the limb, supposing it to be amputated at the knee, with still much greater facility; and, if the limb be amputated high up in the thigh, the mere tonic contraction of these muscles is sufficient to overcome the action of the extensors of the thigh, and keep the stump bent upon the pelvis. This fact every surgeon has witnessed after amputation in the thigh, but more particularly when the amputation is performed a little below the small trochanter. The action of these muscles, which is so evident as to strike every one after amputation, is not noticed in the natural state of the limb, because the power which they have superior to the extensors is counterbalanced by the weight of the limb. Now in effect, as regards the action of these muscles, it very little matters whether the operation that has been mentioned, is performed, or there is a mere solution of continuity in the bone, accompanied with a separation or laceration of those parts which surround it at the seat of injury—I mean the periosteum and such muscles as are naturally inserted into the bone where the fracture exists. The action which the psoas magnus and iliacus internus have upon the limb, is communicated to it by the thigh-bone; but if this be fractured through the whole of its diameter, their action cannot be propagated to that part of the limb which is below the fracture; nor can the weight of the limb resist their action when the bone is broken, except through the medium of the soft parts, consequently the effect of these two muscles in loose fractures will be the same, or nearly so, as if the limb were amputated in the situation of the fracture. Their tendency is to bend the upper portion of the broken bone upon the pelvis, or, in other words, to cause it to assume the flexed position.

The resistance offered to the flexors.

If the fracture run through the bone obliquely, downward and forward, and is accompanied with considerable laceration, the only powers which at first oppose the action of the psoas magnus and iliacus internus, are the extensors of the thigh and the weight of that part of the limb which is situated above the fracture, which they readily overcome; but, as the upper portion of the bone becomes bent upon the pelvis, the broken extremity puts the extensor muscles of the leg upon the stretch; and then, even in this variety of fracture, which is one of the worst that can occur in the thigh, the action of the psoas magnus and iliacus internus, and the bending of this part of the limb upon the pelvis, would consequently be further resisted by the weight of that part of the limb which is below the fracture. This additional resistance offered to the psoas magnus and iliacus internus by the gravity of the limb, is principally conveyed to the upper portion of the bone through the medium of the extensors of the leg, and will be more or less effectual in its operation in proportion to the distance of the fracture from the trochanter minor. Here we see a power exerting its influence upon the upper portion of a fractured thigh-bone, when the fracture is in the middle or lower thirds, which does not exist when the limb is amputated in either of those situations. Hence we may perceive that the upper portion of a fractured thigh-bone is not, under ordinary circumstances, likely to become so much bent upon the pelvis as the stump of a thigh left after amputation

Consequences of transverse displacement.

The pain which the patient experiences when the upper part of the bone is thus bent upon the pelvis, is generally very great, if that part below the fracture be not at the same time raised so as to represent the same degree of flexion. This pain is produced principally by the serrated or otherwise irregular end of the upper portion of the bone which is forced against the inflamed and tender bellies of the extensors of the leg, and of course pricks and tears them in proportion to the degree of irregularity of the fractured surface; and the degree of force which the psoas magnus and iliacus internus exert upon the upper portion of the bone.

Cause of retraction.

The extensors of the leg being irritated by the sharp points of the fractured extremity of the upper portion, and the flexors of the leg, more or less by those of the broken extremity of the lower portion, act together forcibly, sometimes very violently, upon that part of the limb below the fracture, and draw it up towards the pelvis; producing a degree of retraction which varies in different cases, but which sometimes amounts to seven or eight inches.

Reason for speaking particularly of the

It will be recollected that I said something about the action of the flexors of the thigh in the last chapter, when treating of fractures just below the trochanter minor, but on that occasion, I merely mentioned the facts without entering particularly into the explanation of them, which I reserved for this place, in order that I might connect the observations which I wished to make upon the action of these muscles, with some that I have to offer upon the action of the gastrocnemius and popliteus, thinking that they might serve to illustrate each other.

flexors of the thigh in this place.

My readers will recollect that the gastrocnemius externus, takes its origin from the posterior part of the condyles of the femur and is inserted into the os calcis. This muscle is an extensor of the foot or flexor of the leg, or both; and the popliteus, which they will recollect goes from the outer condyle of the femur to be inserted into the upper part of the tibia, is a flexor of the leg. Now, why are these two muscles called flexors of the leg? Because they assist in bending the leg upon the thigh: Granted. But why do they not bend the thigh upon the leg in their ordinary action? Because the femur, from which they arise, is relatively more fixed than the leg. These muscles acting could not so readily bring down the thigh and trunk upon the leg, when their action is op-

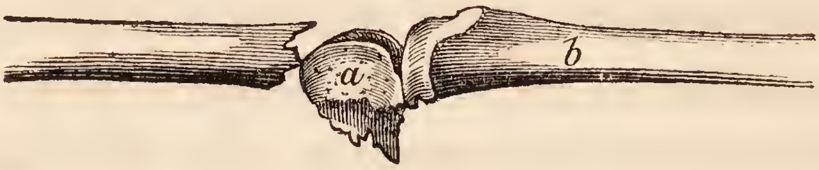
Action of the gastrocnemius and popliteus.

posed by other muscles, as they can bend the leg upon the thigh, therefore they may properly be called flexors of the leg. What is meant by a fixed point when speaking of the action of muscles? I scarcely need add, that it signifies nothing more nor less, than that point which opposes the greatest resistance to a muscle when it is in action. Thus, the scapula is the fixed point for the biceps flexor cubiti, because this muscle, being made to contract under ordinary circumstances, bends the fore-arm upon the humerus; the fore-arm therefore, is the most moveable part, or in other words, opposes the least resistance to the action of this muscle. But those parts or points which, in the natural condition of a limb, are relatively the most fixed, may evidently become the most moveable after an accident. Thus, suppose the coracoid process of the scapula were broken off and separated from the clavicle, and we were to put the coraco-brachialis muscle into action, this muscle would no longer assist in raising the arm and bringing it forward but would depress the coracoid process; because this part which in the natural state is relatively more fixed than the humerus, now admits of being moved by the influence of a less force, in consequence of the injury which it has sustained.

What I have said with respect to the coraco-brachialis, may be advanced with equal truth in considering the influence of a set of muscles, the action of which, I now wish to bring under particular consideration, namely, the gastrocnemius and popliteus.

Effect in fractures of the lower-third of the femur.

We have already seen what effect the flexors of the thigh have upon the upper portion of a fractured femur; we will now see what effect the popliteus, which is a flexor of the leg, and the gastrocnemius externus, which is a flexor of the leg as well as extensor of the foot, have upon the lower portion. We will suppose that a fracture exists at the lower part of the thigh-bone, and that it divides the bone in a direction downward and forward, and that, with such a fracture, the limb is placed in the straight position upon the heel, or the bent position upon the side, and that the leg and lower portion of the thigh are left to the action of the gastrocnemius and popliteus; which would require the greatest force to move it, the leg or the lower portion of the thigh? You would say that part which opposes the greatest weight and length of lever, which is, in fact, the leg. The leg, under such circumstances, is more fixed than the lower fragments of a fractured thigh-bone. The ordinary effect of the action of these muscles is now reversed—the leg and foot are the relatively fixed parts, and not the condyles of the femur as when the bone is entire. What ought we to infer from this fact? What we actually see take place—that these muscles, instead of assisting to bend the leg upon the thigh, do, when this variety of fracture exists, bend the lower portion of the thigh-bone upon the leg, in such a manner that the fractured end passes backward in the popliteal space (*Fig. a*),



This will be the case also when the fracture extends through the bone in a direction downward and inward, or downward and outward.

Effects when one of the condyles is split off.

If the outer condyle is split off, the action of the popliteus and outer head of the gastrocnemius muscles will turn the condyle round in the same way as when the fracture extends through the whole diameter of the bone, while the other part of the femur remains in its proper situation. If the inner condyle be split off, the same thing will occur from the action of the inner head of the gastrocnemius. Of course for these effects to take place in any considerable degree, either in fractures immediately above the condyle, or in cases where one of the condyles only is split off, the fracture must be of the loose kind. This position of the fractured end has obtained, when the parts were inadequately supported, in all the cases of this description that I have witnessed, and I should think that it must occur in almost every instance.

Consequences of displacement.

When, in fractures through the whole diameter of the bone, transverse displacement of the broken ends has taken place, whether from the action of the muscles or from external force, they are made to overlap in the same way as fractures higher up in the femur, by the contraction of the extensors and long flexors of the legs ; and if they be suffered to unite in this situation, the consequent deformity and lameness is very great. The lameness which will take place when either of the condyles is allowed to unite out of its proper relative position, will also be by no means trifling.

Extensors of the leg pierced.

When the fracture divides the bone downward and forward, it sometimes happens that the fractured end of the upper portion penetrates the extensor muscles of the leg, and becomes lodged in their substance. A preparation illustrative of this fact was in the possession of Mr. Paty, a drawing of which is given in Sir Astley Cooper's work on dislocations.

Fractures downward and backward.

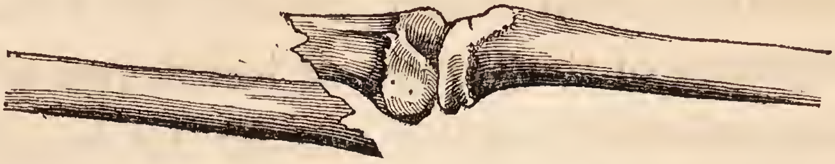
When speaking of fractures which occur higher up in the bone, I took occasion to remark, that those which divide the bone in a direction downward and backward, are the most favourable to treat. This is the case in whatever part of the femur the fracture is situated, and evidently depends upon the manner in which the flexors of the thigh and the gastrocnemius and popliteus antagonise each other. If I have succeeded in making myself understood, it will be seen that a fracture, passing through the lower end of the bone in a direction downward and backward, will not allow the fractured surfaces to be drawn asunder by the simultaneous action of these muscles; but, on the contrary, the psoas magnus and iliacus internus acting in one direction, and the gastrocnemius and popliteus in the other, tend mutually to keep them in close apposition, provided the fractured extremities do not overlap.

Effects of the muscles differ in different cases.

But though these two sets of muscles favour the surgeon's endeavours to keep the broken ends in proper apposition in cases of this description, it must be borne in mind that they have the advantage of one another in all complete fractures, in proportion to the distance of the fracture from either end of the bone, in consequence of the greater or less degree of resistance, offered to either set, by the length of that portion of the bone to which they are attached. For instance, if the fracture be high up, the set of muscles which act directly upon the upper portion will have the advantage in effect of those which act upon the lower portion; and, if the fracture is situated near the condyles, the effect of the muscles attached to the lower portion of the bone will be seen to preponderate. The power which these two sets of muscles exert will be, in all cases, much the same, but the effects will be different.

Evils greater at the lower end than at the upper.

If the broken extremities overlap in fractures extending downward and backward, the consequences differ somewhat at the two extremities of the bone. Just below the trochanter minor, or in the middle of the bone, the only injurious effects may be deformity and lameness; but if they ride considerably when the fracture is situated near the condyles, there may be not only deformity and lameness, but in some cases such a degree of mischief as may lead to the necessity of amputating the limb. Why? For this reason, the keen edge of the upper portion descending into the ham *(Fig. b)*,



may penetrate the artery, and so injure the nerves as to render the operation necessary, in order to save the life of the patient. Sometime since I saw a man who was suffering under the effects of this variety of fracture. In him the fractured end of the upper portion passed by the artery and nerves, and after piercing the integuments projected in the ham, where a portion of it exfoliated. The condition of this poor fellow's limb is a disgrace to surgery, and might have been easily prevented, as I shall hereafter attempt to show.

Influence of other muscles.

In concluding my remarks upon the influence of the muscles which produce the *most* injurious consequences in fractures below the trochanter minor, it is proper to observe that *these* are not the only ones which tend to displace the fragments. The abductors, adductors, and the rotators outward and inward, will also have an effect in deranging the fractured ends in some cases, according to the situation and peculiar state of the fracture; but the influence of these is comparatively trifling, though sufficient to keep the careful surgeon on his guard till the uniting process is completed.

Sec. 2.—*The usual Modes of Treatment employed in Fractures of the Middle and Lower Thirds of the Thigh-bone.*

Before we can understand correctly the manner in which any set of fractures should be treated; we must make ourselves acquainted with the indications which these accidents present; and, having done this, we shall be prepared to comprehend more fully the advantages or defects of the different modes of treatment which have been from time to time resorted to.

Indications.

The indications which, according to my observation, are common to fractures of the middle and lower thirds of the femur are four. 1st. To prevent the fractured extremities from any independent movement, when the patient moves the trunk, or when passive motion is given to the limb. 2d. To maintain the natural length of the femur with the limb in the bent position. 3d. To maintain the natural curved figure of the bone and the fractured ends in close contact. 4th. To keep the foot from turning to the inner or outer side.

The most usual means examined.

The plans of treatment for fractures of the thigh have been so various, that I should despair of being able to give a particular account of them all, were I so disposed. The attempt would take up more room than I intend to devote to this subject, and the perusal more of my readers' time than they would be inclined to give it. I shall, therefore, only speak of those contrivances which are most commonly employed. This part of my duty I enter upon with reluctance, and nothing should induce me to do so, but professional advancement and public good. The contrivances I shall mention, possess, as far as I have been able to discover, all the advantages obtained by the older surgeons, as well as all the improvements to which the moderns can lay claim.

Short splints.

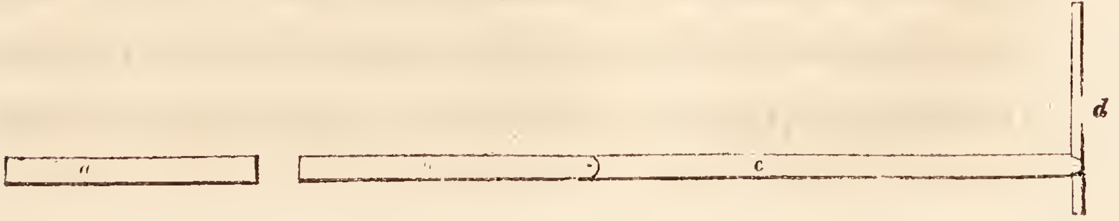
When the short splints, as they are called, are had recourse to, three or four of them, commonly long enough to extend from the pelvis to the knee, are confined round the fractured thigh by means of tapes; usually there is one placed along the outer side of the thigh, another on the inner, a third on the front, and sometimes a fourth behind: and when the tapes are tied, the limb is sometimes laid in the straight position upon the heel; sometimes it is bent and supported by means of a pillow under the knee, and occasionally it is bent and laid upon the outer side. These various positions have been adopted according to the particular fancy of the surgeon.

Remarks.

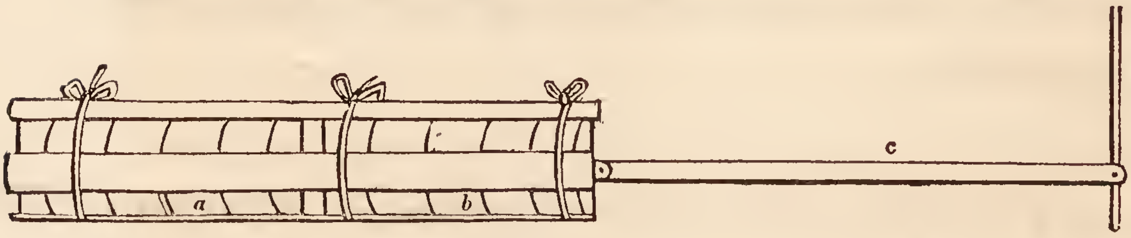
Now this plan is very simple, but does it succeed? Certainly not; for almost as constantly as we see it put in practice, we find the result is deformity of the limb. Let us endeavour to discover the cause of this. It cannot always be attributed to the ignorance or inattention of the surgeon, for it occurs in persons who are under the care of the most scientific surgeons—men who do honour to the age in which they live—who are anxious to obtain favourable results—who feel for their patient's welfare, and endeavour to preserve their own reputation.

Experiment.

I procured four pieces of stick, to represent a fractured femur connected with the bones of the leg and foot (*Fig.* 1). The piece (*d*)



intended to represent the foot, was connected to that intended to represent the tibia *(c)* by a hinge-joint at right angles. The upper end of the stick, used to represent the tibia, was connected to that portion used for the lower end of a fractured femur *(b)* by a hinge-joint. The other piece of stick *(a)*, which was to take the place of the upper portion of a fractured femur, was not directly connected to the other pieces. The portions *(a)* and *(b)* were separately imbedded in shreds of muscles in sufficient quantity to cover the sticks all round, to the thickness of about an inch, and long enough to extend from one end to the other of each. The muscular fibre having been firmly tied to the sticks, with twine passed over it round the sticks in a spiral direction, I placed one end of *(a)* and of *(b)* in apposition, and secured these two portions firmly in a straight line, with four slips of deal (*Fig.* 2), which were equal in length to the two portions *(a)* and *(b)*, and confined them upon the muscular fibre with tapes, in the same manner as the short splints are confined upon a fractured thigh. This is an experiment that



any one can repeat, and in doing so, he will discover that by rotating the piece *(c)*, a rotatory movement will be communicated to *(b)*, but no motion whatever will be communicated to the piece *(a)*. The motion will be found to terminate at that part where the fracture is supposed to be situated, namely, between *(a)* and *(b)*.

Rotatory motion.

From this we might conclude that, when a fractured thigh is put up with short splints, any accidental rotatory motion given to the lower portion of the bone, will terminate at the seat of fracture. This is the case also when any rotatory motion is given to the upper portion by any movements of the pelvis, whether intentional or accidental.

Inference.

By carrying the leg piece *(c)* to one side or the other, so as to represent the motion of abduction or adduction of the leg, the portion *(b)* is moved laterally also, but the portion *(a)* does not move, consequently the centre of motion is between *(a)* and *(b)*. When the portion *(b)* is thus carried out of a straight line with *(a)*, that variety of displacement which I have called "angular displacement," is produced. Precisely the same consequences will

Lateral motion.

be seen to follow lateral movement of that portion of stick *(a)* which is made to represent the upper part of a broken thigh-bone.

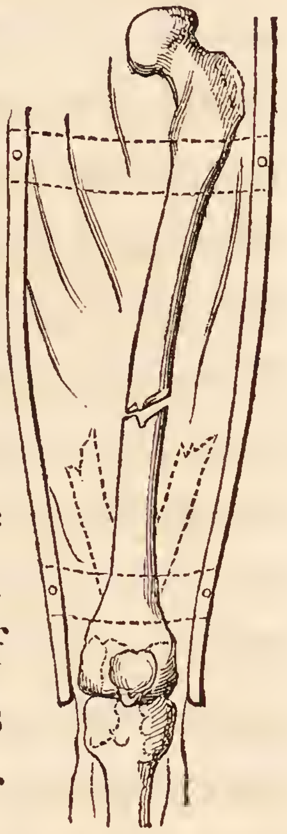
Inference.

From this we might infer that by moving the leg or the pelvis laterally, one of the fractured extremities will be made to move; and the nature of this motion will be the same in the fractured limb if the splints do not reach the condyles, as in the representation of it, provided the impetus be passive, and the muscles be not thrown into action. It seems to me ridiculous to say that motion of the fractured extremities might be prevented by keeping the patient quiet, because this cannot be done to the extent which this sort of treatment would require.

Presumed objection.

But here an objection might be started. It might be said that the short thigh-splints, when they are of a proper length and properly applied, *do* reach the condyles of the femur, and therefore, that variety of motion and displacement which was last mentioned does not take place, in consequence of moving the leg laterally. Granted. But a worse kind of motion takes place under such circumstances. The centre of motion would then be in the situation of the condyles, consequently when the leg is moved laterally, lateral displacement of the fractured end of the lower portion will occur. This will be illustrated by *(Fig. 3)*, in which the parts are represented, so as to show the movement of the lower portion of the femur.

Fig. 3.



Influence in fractures near the upper or lower end.

What I have said applies to fractures through the middle of the bone; but it is to be recollected that, however little the influence which the short splints have when employed in the management of such fractures, it is still much less in fractures situated near the upper or lower end.

But little good results from using them.

Again, is there any thing in the mechanism of these splints to keep up extension? No; to maintain the femur of its natural form? No; to prevent the foot from turning to the inner or outer side? No. Motion and displacement of the broken extremities and shortening of the limb take place, much the same as they would were no splints applied. These splints do not answer effectually a single indication! Hence it is not to be wondered at that deformity of the limb is so constantly the result of this plan of treatment.

Pott's plan.

The late Mr. Pott supposed that the deformity which is so common an occurrence after fractures of the femur, is to be attributed to the action of those powerful muscles which surround the bone, rather than to any other circumstance; and, that this action would become trifling, if the limb were so placed as to shorten the distance between their origin and insertion, or in other words, if they were put in what is called their relaxed position. This idea is for the most part very good, and must be regarded as the origin of much improvement in the setting and treating of fractures. It is acted upon at the present day in the setting of fractures, under the consideration that muscles contract with much less force when they are placed in what is called their relaxed position, than when they are extended or stretched.

I believe we are indebted to Mr. Pott for pointing out to the profession the advantage of applying the knowledge of this fact, which, however, is not without exceptions, to the treatment of fractures; and though he was incorrect in asserting that all the muscles are relaxed by placing the limb in the bent position, and though his treatment was very inadequate to preserve the limb of its natural form, as I shall presently attempt to demonstrate, yet his observations are not, as some would lead us to suppose, to be considered useless. Every one who knows any thing of the treatment of these accidents, must be aware that the relaxation of the muscles is an important indication, especially in some cases ; Mr. P. should therefore be regarded, were it even for the communication of this fact alone, as standing among those who have contributed to the advancement of this department of surgical science.

Mode of placing the limb.

Mr. Pott recommended us to bend the limb, and lay it on the outer side upon a splint, reaching from the trochanter major to below the knee, and keep it in this position till the union is completed. By this mode, he did not, as he supposed, relax all the muscles of the limb, but approximated the origin and insertion of those which I have said have the greatest influence in producing transverse displacement of the broken ends of the bone, namely, the psoas magnus and iliacus internus, and the gastrocnemius and popliteus ; and, if the patient could keep upon his side with ease to himself, this might be considered as one of the best modes of treatment that have been hitherto adopted.

Consequences.

Unfortunately, however, for this plan, when the patient is placed upon the side with the limb laid upon a splint, in the manner Mr. Pott directs, the integuments covering the outer side of the trochanter major are so compressed between the bone and the splint, that they soon inflame; and, if the patient should maintain this position for any considerable period, they often ulcerate or slough. This is one great objection to the treatment which we are now considering. The patient who is treated according to Mr. Pott's plan, must not turn upon his back; if he should do so, and remain in that position, he will have eversion of the foot. But there are few persons who can bear the pain which is occasioned by strict adherence to this mode of treatment. They attempt to relieve themselves by turning round upon the back; and, as the pelvis turns round, it carries with it the upper portion of the fractured bone, while all that portion of the limb below the fracture remains upon the side. If the bone should unite while the fractured ends are thus relatively placed, eversion of the foot will be the consequence. This deformity so commonly occurs when Mr. Pott's plan of treatment is adopted, that the everted foot is now proverbially called "Pott's Foot."*

* Any gentleman may satisfy himself that the upper portion of a fractured femur is rolled inward when the pelvis is turned from the side to the back, by placing himself upon a

In this plan there is no provision made by which extension may be kept up, and therefore shortening of the limb, more or less, is almost as constantly observed as eversion of the foot. In short there is not *one* of the four indications I have mentioned, properly answered by Mr. Pott's method of putting up a fractured thigh; it is a method, therefore, which I cannot recommend.

Retraction of the limb.

Indication not answered.

This plan of treatment, however, coming from Mr. Pott, a man of considerable eminence in his profession, attracted much attention, and was tried upon an extensive scale. But sur-

Tried extensively.

plain surface, with the limb bent and laid upon the side, by noticing the manner in which the limb lies when the body is upon the side, and when it is upon the back. He will find that the limb lies very comfortably upon the outer side, as long as the trunk is kept in the same position; but when the trunk is turned round upon the back, he will observe that the upper end of the limb will be raised from the plane by the action of the adductor muscles, consequently an equal bearing of the limb from the foot to the trochanter is not maintained. The limb is somewhat twisted, and soon becomes painful, apparently from the weight which is thrown upon these muscles. If the femur is broken, the rotatory motion of the upper fragment, which, in some measure, keeps pace with the rotatory movements of the pelvis, prevents the occurrence of the pain here alluded to.

geons soon became acquainted with the inconveniences I have mentioned, and, at the same time, were not inattentive to the advantages which are derived simply from the bent position of the limb. The apparatus employed for supporting the limb in this position without the necessity of placing it upon the side, was the double-inclined plane, or common fracture-box, of which I shall now speak.

The common fracture-box.

Though the common double-inclined plane might be employed, so as to prevent eversion or inversion of the foot, and to maintain the limb in the bent position, yet, after what I have said respecting it elsewhere, (*see* pages 192 and 254) few, I think, will be disposed to use this contrivance in the management of fractures of the middle or lower third of the femur. This apparatus supports the lower portion of the limb, when confined upon it in the manner I have stated, in a proper position; but it gives so little support to the upper, that whatever direction the pelvis moves in, the pelvic portion of the bone moves with it, without producing a corresponding movement in the lower portion. The disturbance of the fractured parts thus occasioned, is for a time productive of pain, and, as I have attempted to show, much retards the union.

This contrivance does not enable the surgeon to keep the limb of its proper length when the fracture is in the middle or lower thirds of the femur, any more than it does when the fracture is situated in the upper third; therefore, when transverse displacement of the broken ends of the bone is effected, riding will take place from the same causes which give rise to it when the fracture is in the upper third.

Does not keep up extension.

It is, however, a prevailing opinion, that the double-inclined plane or fracture-box does keep up constant extension of the limb. That it might be applied so as to produce some extension of the limb, I well know; but to depend upon this apparatus as a proper extending power is palpably erroneous. Some extension of the thigh is made by the weight of the leg and foot, as they lie upon the plane of the apparatus, destined to support them, but this is very inefficient. We are gravely told, however, by some surgeons, if the weight of the leg and foot is not adequate, the limb should be drawn firmly over the apparatus, and the foot fixed to the foot of the bedstead, or to the lower end of the apparatus. Were the limb made of materials as flexible as a rope, it might be thus extended, but we must regard the limb as consisting partly

Remarks upon the extending power of the double-inclined plane.

of bones which do not admit of being bent and twisted about in the manner which might be inferred from the practice here recommended. In whatever part of the femur the fracture may happen to be situated, we perceive that the effect of extending the limb in this way would not be to draw the broken ends of the bone asunder in the natural line of the bone, so as to bring the limb of a proper length, but to displace them in the transverse direction. When the limb is extended in this way, we act with the lower end of the femur as with a common lever, the fulcrum of which is formed by the angle of the apparatus ; and as the condyles are drawn down in consequence of the force which is applied to the leg and foot, the fractured end of the lower portion of the bone is raised or tilted forward, and not extended simply in the natural line of the bone, which is the only direction in which extension ought to be kept up. In one case where this plan was pursued, in order to obviate the shortening which had taken place, I saw the knee-joint laid open and the posterior part of the os calcis bared. In this case, the extension kept up pressed the condyles of the femur with such force against the angle of the apparatus, that absorption of the integuments and capsular ligament took place. I scarcely need add that the patient's sufferings continued very great till death closed the scene. Great inconvenience is always experienced when this mode of extending the limb is resorted to, but I have never seen a single instance where it produced the desired effect.

Inference.

From these facts I infer, that the double-inclined plane ought not to be employed in the management of any fracture of the thigh, whether in the upper, middle, or lower third. It answers in a proper manner, only *one* of the indications I have mentioned.

Difficulties experienced in choosing the best plan.

The profession have been much perplexed by the encomiums which have been laid upon different modes of treatment; and many surgeons have for some time been inclined to treat the subject of fractures lightly. Conceiving that nothing more could be done to support the fractured parts in proper apposition, than the means which have been advised by the eminent individuals who have written upon these accidents, they have been disposed to attribute the occurrence of deformity, in every case, to the influence of muscular contraction, which they consider no power, which allows of being safely employed, can control. But from the conversations which I have had with patients who are suffering from deformity in consequence of fracture, they are not readily brought to indulge in a similar opinion. An injury which leaves a patient lame for life is, to him at least, a matter of serious import; the causes of which should not be neglected, nor treated with indifference. He thinks but little about the action of muscles —a subject of which he has no clear conception. The deformity of his limb, and it may be the consequent claudication, become the subjects of conversation among his friends, who naturally enough exclaim, "your limb was badly set—who was your surgeon?" and, whether the surgeon be in fault or not, his patient will be a living monument to the injury of his reputation.

To return—surgeons, I say, have been distracted by the different plans that have been laid before them, and have therefore sometimes tried one contrivance, and sometimes another. They have found that most of them possess some advantages, but at the same time, they are seldom able to prevent the riding of the bone, and preserve the natural figure of the limb. Indeed, so commonly does retraction of the limb occur under the use of the different contrivances usually employed, that I have heard a celebrated lecturer (now retired) in this town, publicly assert, that he never saw a fractured thigh-bone that had united, without riding of the fractured ends! Some surgeons make use of the short thigh-splints, *because they are easily applied*; others recommend Mr. Pott's plan, because it relaxes the muscles; some employ the double-inclined plane, because it has the advantage of relaxing the muscles, and, at the same time, might be so applied as to prevent eversion or inversion of the foot, which, as I have said, is the usual result of Mr. Pott's method. Others again employ an apparatus which confines the limb in the straight position, because neither of the former plans enables them to keep up permanent extension. In adopting this mode, however, they are obliged to sacrifice the advantages which might be obtained from the bent position, and also do violence to the natural figure of the limb.

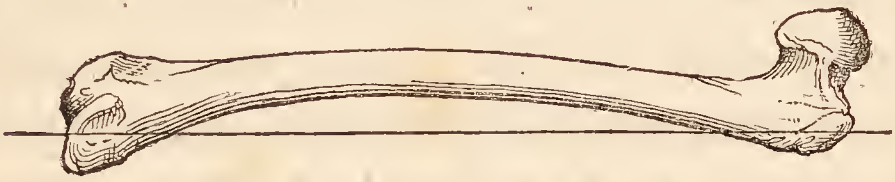
Straight position.

The principal advocates for the straight position, are Desault and Boyer (*see* pages 195 and 260). These celebrated surgeons considered that permanent extension is a matter of the greatest consequence in the treatment of fractures of the thigh, and they believe that any apparatus by which this can be accomplished, will be more beneficial to the patient from this circumstance alone, than any of those which admit of relaxation of the muscles, but not of extension of the thigh. This is, perhaps, a difficult question to decide, nor shall I trouble my readers with any observations upon it. Much ingenuity, however, has been shown by the advocates of each kind of practice. My object in speaking of the different plans now commonly adopted, shall be to point out, to the best of my ability, in what respect they may be considered advantageous, and at the same time, to make my readers acquainted with those indications which, it may be plainly shown, the contrivances usually had recourse to are not calculated to fulfil.

Boyer's apparatus—consequences of using it.

Boyer's apparatus is (*see* p. 199) by far the best that I have seen, among those in common use, for keeping up extension, when the limb is placed in the straight position. It is, indeed, most effectual in this respect. But unfortunately it may be applied so as to keep up extension, and that is all. In order to see the consequences which follow the use of Boyer's apparatus, even under the most favourable circumstances, it is necessary to bear in mind the natural figure of the thigh-bone, which is not straight, but forms a segment of an irregular circle; the natural form of the limb, which is not straight but bent inwards at the knee; the action of those muscles which are so placed as to effect most powerfully the broken extremities of the bone; with these facts before him, every scientific surgeon must feel that the necessary degree of extension is not likely to be made by Boyer's ingenious contrivance, without altering the natural figure of the thigh-bone. Instead of forming a segment of a large circle *(Fig. a)*, it would be made to form two smaller segments *(Fig. b)*, the fractured ends would be more or less drawn out of their natural direction, even supposing the muscles were entirely passive. But it will be recollected, that the muscles always maintain a certain degree of contraction by virtue of their tonic power; the effect of which is more or less injurious according to the situation of the fracture, the direction it takes through the bone,

Fig. a.



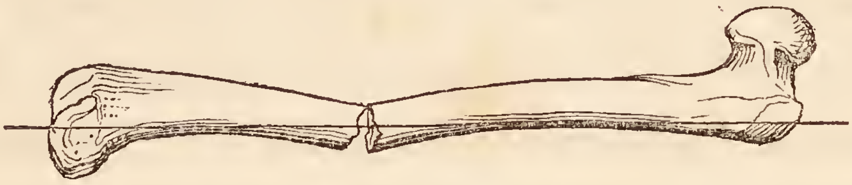


Fig. b.

the degree of laceration and comminution which may accompany it, and the mode of treatment adopted. Let us picture to ourselves a fracture just below the trochanter minor, passing through the bone obliquely downward and forward, obliquely downward and inward, or obliquely downward and outward, and attended with considerable laceration of the soft parts; and let us suppose that the limb is placed upon the heel in the straight position, and kept extended by Boyer's or Desault's contrivance, and then consider the action of the psoas magnus and iliacus internus, which tends to bend the upper portion of the bone upon the pelvis, and the action of the gastrocnemius and popliteus, which tends to bend the lower portion upon the leg, and we shall immediately perceive that this position is not indicated. By it these muscles are put upon the stretch, or I may say, perhaps more properly, that the straight position of the limb puts these muscles into their elongated position, which, according to the general opinion of surgeons, enables them to act the most powerfully; the consequence of which is, in all ordinary cases, a separation of the fractured extremities of the bone, the upper portion being bent upon the pelvis, while the lower is drawn in the opposite direction.

But we will suppose that the fracture is situated in the lower third of the femur, that it divides the bone in one of the directions I have just mentioned, and that it is of the loose kind, what will be the probable result of placing and extending the limb in the straight position ? Here the upper fragment will be acted upon with the same power as when the fracture is high up, but with less injurious effects; here the gastrocnemius and popliteus will be the principal agents in producing displacement and deformity ; but in the former case the flexors of the thigh. The gastrocnemius and popliteus bend the lower portion upon the leg, as I have said, and produce that variety of deformity which is represented in *Fig. a,* page 290. The condyles *(a)* are turned round upon the tibia *(b)*, and are placed in that relative position with respect to it, which they assume when we bend the knee ; the consequence is, that the patient has not only great weakness in the knee, but his power of bending it is sometimes very limited. I remember the case of a man, in whom the fractured parts were suffered to unite as here described, and the result was, that the man was neither able to throw the weight of his body upon the limb, nor flex the leg. In this case the lower portion of the bone was united at a right angle, or nearly, with the upper, its fractured end projecting in the ham.

In young persons.

If this variety of deformity should occur in an individual during the growth of the body, and should not be very great, the patient will, after the lapse of a long period, regain the power of the limb, and be able to walk with tolerable facility ; because Nature in a great measure remedies the evil, in depositing the new ossific matter for the growth of the bone. In such persons, the deformity which takes place in consequence of fracture, becomes greatly diminished ; but I am not aware that the bones are ever elongated when they are once united with the broken extremities overlapping.

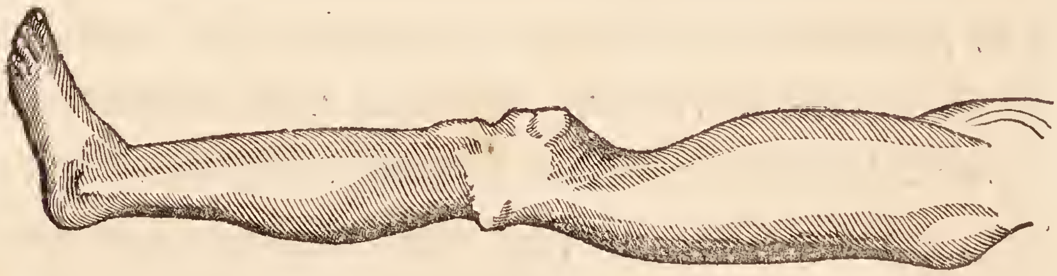


Fig. a.

The accompanying diagram *(Fig. a)* represents the appearance of a boy's limb, after the union of a fracture just above the condyles. The fracture passed through the bone in a direction downward and outward. The condyles were turned round considerably upon the tibia, and were drawn up along the inner side of the shaft of the femur, the fractured end of which penetrated the integuments at the head of the fibula and exfoliated. The treatment in this case was by means of Boyer's apparatus, under the direction of one of our best surgeons.

This apparatus acts injuriously in all cases.

From what I have said, it will appear that Boyer's apparatus is more admissible when the fracture is in the middle of the bone, than when it is situated near either of the extremities, because those muscles whose action is so injurious in producing transverse displacement, when the fracture is a little below the trochanter minor or a little above the condyles, are resisted by a greater length of lever, and their action may usually be overcome; consequently the displacement, in such cases, will principally be that which arises from extending the limb in the straight position; but the deformity which arises in consequence of this displacement, is sufficient to prevent me from recommending the adoption of Boyer's ingenious contrivance, even in fractures of the middle of the femur.

Sir A. Cooper's modification of Boyer's splint.

Sir Astley Cooper had an apparatus made for the purpose of confining the limb in the straight position, which he announced in his lectures, in the year 1820 or 21, as being nearly ready for use, and which Sir A. C. thought would prove most particularly applicable for fractures of the upper and lower-thirds of the femur. This apparatus is decribed in his lectures by Mr. Tyrrell, in the following words: "It consists of a straight splint, long enough to reach from the upper and inner part of the thigh, as far as several inches below the sole of the foot; the upper extremity is hollowed and padded, so as to fit in between the scrotum and thigh against the side of the pubes, and the lower part resembles that described and employed by Boyer—having a boot which fixes by the sole to a bolt, projecting at right angles from the splint; the bolt is connected with a screw, let into the lower part of the splint, and on turning this screw, the bolt is carried upwards or downwards, according as the screw is moved to right or left."

Application.

The direction for the use of this apparatus is thus stated: "After having liberated the rectus muscle from the broken extremity of bone, by bending the knee as before directed;—the limb is to be extended, and the apparatus applied on the inner side of the limb, in the following manner:—The upper padded end being placed between the scrotum and thigh against the side of the pubes, the foot is to be received into the boot, and confined there by closing the front with a lace in the usual manner, or with straps and buckles ; then, by turning the screw, the bolt connected with the sole of the boot, and consequently the boot and foot, are made to descend, thus a powerful mode of extension is afforded, the upper part of the splint being fixed against the pelvis, the whole force of the instrument is exerted upon the limb."

Remarks.

I have seen this contrivance used in two or three cases of fracture of the thigh, but never when the fracture was near the upper or lower extremity of the bone; and from what I observed, I was unable to collect any thing which was likely to render its employment more beneficial than that contrived by Boyer. Like Boyer's apparatus, it subjects the patient to all the evils arising from the straight position. It does not, however, force the upper portion of the bone outward, an evil which is attributable to the influence of the oblique thigh-strap, with which Boyer makes counter-extension. But the skin covering the pubes, appears to be ill-adapted to bear pressure, for I observe that considerable inconvenience is experienced at this part from the influence of the apparatus ; and this is sometimes so great, that the necessary degree of extension cannot be borne. This, however, might arise from the construction of the upper end, which, possibly, may not always be padded sufficiently for the purpose for which it was intended. But still, excepting the operation of the oblique thigh-strap, the influence of this contrivance will be the same as that by Boyer, and I am not acquainted with any single variety of fracture for which, in my opinion, its employment can be supported upon principle.

SEC. 3.—*The Author's Treatment of Fractures of the Middle and Lower-thirds of the Thigh-Bone, with illustrative Experiments and Observations.*

Having, in the preceding Sections, spoken of the causes, nature, and symptoms of fractures as they usually occur in the middle and lower-thirds of the thigh-bone, and commented upon the modes of treatment usually advised ; it now devolves upon me to inquire into the merits of that practice which I consider is the best.

The limb to be fixed in relation to itself.

In the course of my observations upon the action of the different contrivances which are commonly had recourse to in the management of fractures of the femur, I was led to suspect that one grand principle in the treatment of fractures is to fix the whole limb, so as to prevent any motion from taking place in the fractured part, when an impetus is given to the limb either above or below the fracture.

Natural connexions and movements.

In order to understand the manner in which this might be accomplished, it is proper to bring before our minds the natural connexions of the bones of the limb, and the manner in which they move upon one another. It will be recollected that the thigh is connected to the pelvis by a ball and socket-joint; that the leg is connected to the thigh by a joint that has a hinge-like motion, and so is the foot to the leg; and that the pelvis is passive to the motions of the thigh—the thigh to the motions of the leg—and the leg to the motions of the foot. From these facts we may infer, that if the pelvis, leg, and foot, were fixed by an inelastic body continued from one to the other, the femur would also become fixed, provided it were entire; because the femur in a natural state cannot be moved without carrying with it the leg or the pelvis. Here we see that the femur might be relatively fixed by means which are calculated to prevent any independent motion of the leg or the pelvis, with respect to one another; but how far could this be accomplished by the same means, supposing the bone to be divided by a fracture? The femur in the natural condition of the limb is prevented from moving independent of the leg or the pelvis, by its natural attachment; but when it is divided by a fracture, the two portions might move without any corresponding movement of the leg or the pelvis; it would, therefore, evidently require additional support to prevent the fractured ends from moving upon one another, under the influence of passive motion given to the limb either above or below the fracture, or simply from the action of the muscles.

Action of the Muscles.

That action of the muscles which is under the command of the will might be exerted or controlled at pleasure, with the same facility as we will the motion of the limbs in the act of walking, or suffer them to remain at rest as when we sit. It is, therefore, against the influence of the tonic or involuntary power, that we have particularly to guard. This power the patient cannot control; hence it would be necessary to have recourse to mechanical contrivances foreign to the limb, in order to prevent those injurious consequences which it might otherwise occasion. This consideration led me to the question, whether there were any means in use, or whether any could be devised by which the pelvis and the leg might be relatively fixed, and the effects produced by the tonic contraction of the muscles prevented—means which might be made to answer both these particulars, and which might, at the same time, be easily borne by the patient.

Controlled by the fracture-bed.

Now these indications might be very effectually answered by the fracture-bed, which I have recommended for fractures of the upper-third of the thigh-bone (*see* page 211). This contrivance, however, confines the patient always to one position; and though this is advisable, and even necessary, for the successful management of most of the fractures of this part of the femur, it does not consequently follow, that absolute quiet of the pelvis is required when the fracture is in the middle or lower-thirds; and if we can discover any means by the use of which entire rest of the pelvis might be rendered unnecessary to a favourable result, we shall, I think, in many instances, add much to the comforts of the patient.

Experiment.

Having ascertained by observation and experiment, that the short thigh-splints, as they are called, give inadequate support to the fractured parts, I had recourse to the same mode of proceeding, in order to discover whether splints extending from one end of the limb to the other, would be more effectual. The short slips of deal used in my first experiment having been removed, I surrounded the muscular fibre with strips of deal *(Fig. 5)*, the length of the three sticks *(a, b, c,* page 297*)* used to represent the leg and a fractured femur. These strips of deal I connected with the cross piece, *d,* which was placed to represent the foot at the lower end of the longer stick, and secured them in close contact with the muscular fibre, covering the thigh portions of stick, *a, b,* by tapes as before. When the whole was thus connected, I found that, by moving the foot-part, *d,* I communicated a simultaneous movement to the different pieces of stick, and that *no independent* motion of either piece was produced. They moved in the same direction and maintained the same

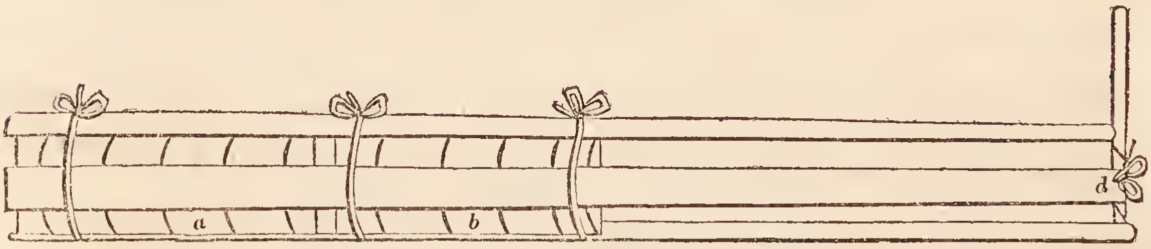


Fig. 5.

relative line when the foot-part was rotated, carried up or down, or to either side. This being the case, of course there was no independent movement of the approximated ends of the two upper portions of stick, *a*, *b*, where the fracture was supposed to be situated. But, with a view to remove all doubt upon this point, I left the approximated ends of these two pieces of stick bare, so that they could be noticed, particularly when motion was given to the whole, by moving the foot-stick, *d*.

Inference.

Now a fractured thigh, put up in the same manner, would be placed under very similar circumstances, as far as regards mechanical effect, with the exception, that the muscles might act spasmodically, or they might act under the influence of the patient's will at the time the limb is being rotated. But the spasmodic action of the muscles is commonly trifling, provided they are not irritated by the broken extremities of the bone, which never happens unless the ends of the bone are displaced; and, as far the voluntary action, this is under the patient's control; therefore, we have nothing left which could be said to derange the fracture but the tonic contraction of the muscles; and, as this is the same whether the limb be moved or not, I was led to conclude, that there is nothing in the nature of a fractured thigh, which would place it under circumstances differing in any material degree, as far as respects the influence of apparatus, from what I put together to represent it; and, that a fracture in the middle or lower thirds of the femur, put up in the manner indicated by this experiment, might be *passively* moved with equal facility, and also with as little danger of producing motion of the broken ends of the bone, when an impetus is passively given to the limb below the fractured part, provided the patient does not resist the movement of the limb, by voluntarily exerting its muscles. The impetus given to the limb below the fracture, would not be felt in the fractured part, but would be propagated along the splints over it to the hip-joint, where the centre of every movement would be placed.

The effects of moving the pelvis upon the upper end of the femur.

In the course of this inquiry, I dare say it has occurred to some of my readers, that though an impetus given to the limb *below* the fracture, does not produce any independent movement of the fractured ends, supposing the limb to be surrounded and secured by long splints as indicated by this experiment, this does not tend to show that any motion, communicated to the limb *above* the fracture, would not centre in the situation of the fracture. When the upper end of the piece of stick, *a,* which is intended to represent the upper portion of a fractured femur, is moved by means of the fingers applied to *it,* the effects of the impetus is observed to be confined to this piece—a movement independent of all the other pieces takes place, the centre of which is where the fracture is assumed to have occurred. The upper portion of a fractured thigh would be acted upon in the same way, by certain motions of the pelvis, as the stick is influenced by the force which is applied to it by the fingers. The only motion of the pelvis which would not more or less effect it, would be, that in which the pelvis simply rolls upon the head of the thigh-bone. This, however, is not the only movement which the comforts of the patient require, therefore it was necessary to find out some plan by which the effects of certain motions of the pelvis might be prevented. I was led to believe, that the best mode of doing this, was to connect the splints with the pelvis, so that any motion given to it by the patient, might be propagated to the splints in such a manner that they should receive the impetus instead of the head of the bone, and communicate it equally to the whole limb. This seemed to be at first a matter of some difficulty, but I shall hereafter endeavour to show that, with care on the part of the patient as well as the surgeon, it might be easily accomplished.

What I have said in relation to the last experiment, has reference merely to the comforts of the patient and the security of the fracture, from the effects of motion given to the limb either above or below it; but there are other important indications which equally demand our attention.

Other indications to be answered.

We must not forget that a well-formed limb turns inward at the knee—a circumstance which will render it somewhat difficult, without great complication, to adopt lateral and front splints in such a manner that they may bear equally upon the different parts of the limb. Here then it appeared, that we must either submit to great complication of apparatus, or lose the advantages indicated by the last experiment. It occurred to me, however, that it might not be necessary to apply four splints, long enough to reach from one extremity of the limb to the other, and in order to throw some further light upon this subject, I varied the last experiment in the following manner.

Experiment.

After I had removed the long slips of deal previously used, I took a piece of the same length, but rather wider, and nailed upon the lower end of it at a right angle, a short piece as a foot-board. I then placed the sticks, the two upper ones *(a b,* page 211*)* being surrounded as before with muscular fibre *(Fig.* 6*)*, upon the wide slip of deal,

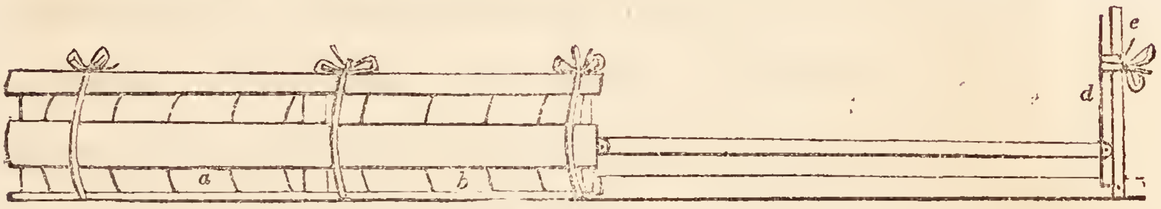


Fig. 6.

and tied the toe of the foot-stick, *d*, to the foot-board, *e*, and placed, also, upon the two upper or thigh portions of stick, three slips of deal, equal in length to these two portions, so that my short splints extended from the upper end of the stick, *a*, to the first hinge-joint, or that I made to represent the knee; and my long splint from the upper end of this stick to below the foot-stick, *d*. These were confined in contact with the muscular fibre with tapes, as in my last experiment. I now began to move my artificial limb in different directions, which I found I could do with great freedom, without producing the least apparent motion between the approximated ends of the two upper portions of stick, *a*, *b*. They all moved simultaneously, as when the four long splints were used; and this was the case whether the impetus was given to the foot-board attached to the under or back splint, or to one of the circular tapes, which confined the whole of the splints upon the muscular fibre; but I observed that the simultaneous movement of the sticks was produced with more certainty when the impetus was given, by acting upon the circular strap nearest the knee; for, when the impulse was communicated through the foot-board only, a slight twist might occasionally take place, which, however, was seldom perceptible.

Inference.

From this experiment, I inferred that a fractured thigh put up in the manner here indicated, might be passively moved in any direction, without any danger of causing the fractured ends to move upon one another, provided that the impulse be communicated to the limb below the fractured part, and in such a manner as to act first upon the splints or circular straps.

Observations.

Thus, then, it appears, we may fix the fractured parts sufficiently to prevent any motion in the fracture, without having recourse to that degree of complication in our apparatus which the particular figure of the limb seemed to require; and, if we grant for a moment, that the motions of the pelvis are prevented from having any improper influence upon the pelvic portion of the bone, which I shall presently attempt to show might be easily accomplished, we shall have discovered a method of answering a most important indication, *viz.* preventing any independent motion of the different parts of the fratured bone, when passive motion is given to the limb, in consequence of an impetus received either above or below the fracture. But we have still other important indications to answer.

Position.

I have said we should maintain the natural length of the bone with the limb in the bent position. The bent position is particularly indicated, because it relaxes those muscles which tend most to displace the fractured ends in the transverse direction, and because it prevents in a great measure the stiffness in the knee, which sometimes results from confining the limb in the straight position. If we could gain no other advantage from the bent position than this, of being able to restore the freedom of the joint with greater facility, it would be advisable to adopt it, except in cases where it would oppose the accomplishment of indications still more important; for patients are sometimes several months regaining the flexibility of the knee, after the limb has been kept for a long time extended.

Extension.

But how, with the limb in the bent position, is retraction to be prevented? Not by attempting to draw the limb over a double-inclined plane, for, from this practice, the most serious evils sometimes ensue; not by acting upon the thigh, by placing a ligature round it above the knee, and extending it by means of the ligature fastened to a pully or otherwise. All these modes of extending the limb are often productive of great mischief. Some other plan therefore must be thought of, by which this desirable object may be accomplished. When reflecting upon this subject, it occurred to me, that the tuberosity of the ischium, which is well covered by hardened integuments, and the back of the leg which is well cushioned by the muscles of the calf, would form good points of bearing for any means well contrived to resist the action of the extensors and long flexors of the leg. Of the peculiar construction of these parts I have availed myself, as will hereafter appear, with the greatest advantage to the patient.

The curved figure of the bone.

The third indication I have mentioned, is to maintain the natural curved figure of the bone, and the fractured parts in close apposition. When this indication is neglected, we generally find the femur bent out of its natural line backward or forward, or to the inner or outer side; and, in this unnatural position, it sometimes happens that only small portions of the fractured surfaces become united; the consequence is, weakness in the limb for a long time after the union has taken place, and not unfrequently rupture of the callus. Those who would guard against such unfavourable results, must be careful to employ their apparatus in such a way as to support the fractured bone on all sides, and press the fractured surfaces together.

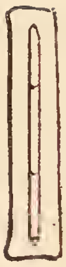
Position of the foot.

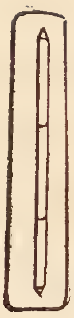
The fourth and last indication I have particularly pointed out as necessary to be answered in the management of fractures of the femur, in order to prevent deformity and lameness, is the position of the foot, which must be supported in a natural position with respect to the other parts of the limb. When this indication is not properly attended to, the foot becomes twisted to the inner or outer side, and the consequence is, even if the bone be united of its proper length or nearly so, the patient has an awkward gait in walking, often amounting to absolute lameness.

Having ascertained all these principles and facts relative to the treatment of fractures of the middle and lower thirds of the thigh-bone, the next desideratum was to possess an apparatus by which we may be enabled to turn them to the advantage of the patient.

Author's apparatus.

The apparatus which I use in the management of fracture of the middle and lower thirds of the femur, and for various other purposes, may be divided into three portions, independent of splints and straps, one of which is for the thigh (*Fig.* 1, *a*), another for the leg, *b*, and the third for the foot, *c*. Besides this assemblage of parts I use, in the management of fractures of the thigh, a pelvis strap (*Fig.* 3), and three short splints (*Figs.* 4, 5, 6). When the thigh and leg parts *a*, *b*, (*Fig.* 2) are connected together in the straight position, and the foot-board attached, it will be seen that it forms a long straight splint, with a foot-piece, as indicated





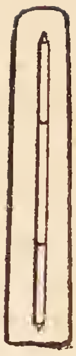


Fig. 4, 5, 6.

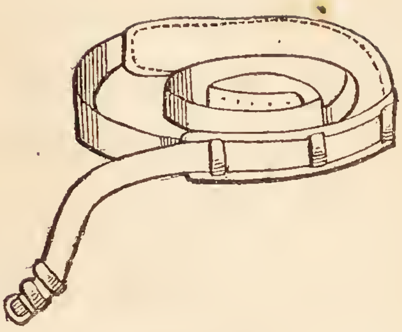


Fig. 3.

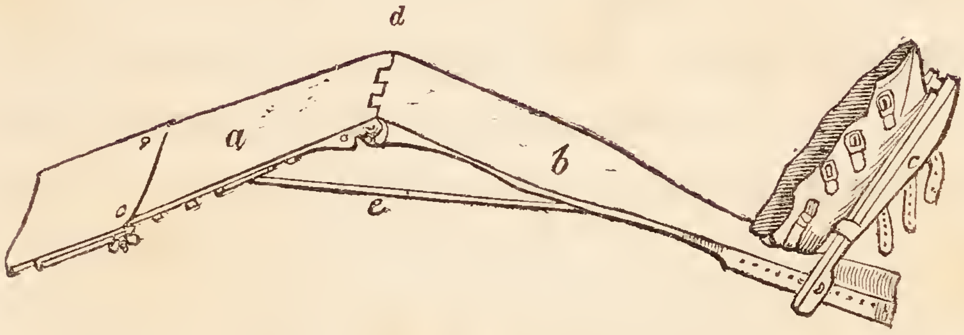
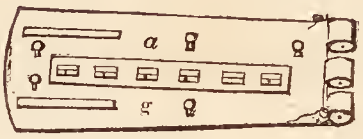


Fig. 1.



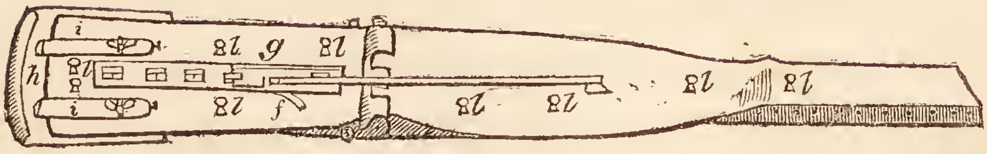


Fig. 2.

by my last experiment. The upper or thigh portion extends as far as the first joint, and is shaped so as to receive and support the back of the thigh, and, when properly padded and placed, to preserve the natural curvature of the thigh-bone. There are two thigh-pieces, *a, a,* made to each apparatus, one of which is bevelled off at the lower end to the right, and the other to the left, so that when one of them is fixed to the leg-piece, which is hollowed out to receive the back of the leg, the leg and thigh-pieces together are adapted to the natural line of the *right* limb; and, when the other thigh-piece is joined to the leg-piece, they are adapted to the natural line of the *left* limb. This arrangement is necessary, in order to preserve the figure of a perfectly-formed limb, which is not straight, but turns inward a little at the knee. The leg and thigh portions are connected together by means of a little steel or brass pin, *d.*

I mentioned the great importance of fixing the limb in the bent position. I have not been inattentive to this indication in the construction of my apparatus. Behind the apparatus is a steel bar, *e,* coated with brass, and fixed to the back of the leg-piece. To the upper end of this bar is fixed what I call a brass foot *(Fig.* 2, *f*), to which is attached a bolt, acted upon by a spring. There is a hole in the centre of this brass foot, which is traversed by the bolt in the transverse direction. At the back of each thigh-piece is a rack, *g*, with several projections, each of which has a hole bored through the middle, for the purpose of receiving the bolt attached to the brass foot-piece. The brass foot-piece is so connected with the steel rod, that it might be easily fixed upon either of these projections. When it is fixed upon any one of these, except that nearest the leg-piece, the leg and thigh-pieces become fixed together, so as to form a double-inclined plane, (*see Fig.* 1), the angle of which may be varied at pleasure, by altering the position of the brass foot-piece from one of the teeth or projections of the rack to another. These teeth are so arranged, that the leg and thigh-pieces of the apparatus might be fixed at several different angles, from straight to a right angle, in order to suit the circumstances of the fracture. At the upper end of the thigh-piece is a sliding brass plate (*h*, *Fig.* 2), so adapted that it might be applied to the upper part of either of the thigh-pieces at pleasure. By this contrivance, the thigh-part of the apparatus might be regulated with great nicety to thighs, which vary considerably in length. The upper end of this plate is turned off, so that, when it is properly padded, it might bear against the tuberosity of the ischium without injuring the integuments. At the back of the sliding-plate is placed a couple of brass bars, *i, i*, which answer the double purpose of rendering the sliding-plate more secure when it is fixed upon the thigh-piece, and of preventing the pelvis-strap, which I shall presently more particularly notice, from slipping from the apparatus. There are little studs, *l*, placed at the back of the apparatus, for the purpose of receiving the straps by which the apparatus is confined to the limb.

Apparatus to be connected with the pelvis.

In the course of my remarks upon the indications which should be answered in the treatment of fractures of the middle and lower-thirds of the femur, I observed that, unless the apparatus be in some way or other connected to the pelvis, motion of the fractured parts might be produced, by the different motions of the pelvis; as the upper portion of the femur must necessarily follow the motions of the bones to which it is connected. This I illustrated by producing motion at the approximated ends of the two portions of stick, which I used to represent a fractured femur. This was done by the force of the finger applied to the upper end of the upper of these portions of stick. Now, as far as any impetus which causes the head of the bone to move backward or forward, or to either side is concerned, the effect produced in the fractured part, would be similar to that produced in the upper portion of stick, allowing for any little variation which a momentary action of the muscles may occasion; but the motion produced by rolling the upper portion of stick, would not occur in a case of fractured thigh, because the pelvis moves readily upon the head of the femur in all directions; consequently, the upper portion of the bone would not obey the slight rotatory motions of the pelvis, but of course it would be influenced if the rotatory motion of the pelvis be compounded with any other variety. Were this compound movement to take place, the upper portion of the bone would be at once carried out of a natural line with the lower. The fact that the pelvis may roll slightly upon the head of the thigh-bone, or the head of the thigh-bone upon the pelvis, is very important to recollect in the treatment of these cases; for, when the thigh is properly supported, the surgeon may roll it outward, so that it may lie between the position upon the heel and the side, and replace it upon the heel at pleasure with impunity. We must, however, guard against that motion, which might be produced in the situation of the fracture, by raising the pelvis, or by carrying it to either side. This can be done only by connecting the apparatus with the pelvis, so that the apparatus shall receive the impulse, and not the upper end of the femur.

Pelvis-strap.

I employ for this purpose a strap, guarded with a sliding pad, and long enough to reach round the thigh and round the pelvis. This strap, represented by *Fig.* 3, must be regarded as a very important part of the apparatus, when it is used for fractures of the thigh.

Short splints.

It will be recollected that, in my last experiment, I made use of one long back splint, and of three which were the same length as the two upper pieces of stick ; these were applied, and secured upon the muscular fibre, and when the foot-piece of the long portion was fastened to the foot-stick, they were found sufficient to prevent any independent motion of either of the pieces of stick, when an impetus was given to the splints, so as to cause them to move simultaneously in any direction. Acting upon the strength of this experiment, I have had constructed three short splints *(Fig.* 4, 5, 6), which should be long enough to reach from the upper end of the thigh, to the lower part of the condyles of the femur. Great care should be taken to have these splints made so as to give equal support to the lateral and front parts of the thigh. If this caution be neglected, transverse displacement will be likely to occur, and consequent deformity. The longest of these splints is adapted to the outer side of the thigh, the next in lengh to the front, and the shortest to the inner side. They have all a strap placed upon their convex side, the use of which will presently appear.

So much for the apparatus, as far as relates to fractures of the thigh; now for the mode of using it.

Application—To be adapted to the sound limb.

When called to a case of simple transverse fracture of the thigh across the middle, the surgeon should first observe, whether the fracture is in the right or left femur, and should connect the thigh-piece, which is proper for the limb in which the fracture exists, to that portion of the apparatus destined to support the leg, and fix them together at an angle of about sixty degrees, which is a sufficient degree of flexion for a fracture in this situation. This may be done accurately enough by putting the brass foot-piece upon the fourth tooth of the rack. The surgeon should then place the apparatus with the brass plate connected under the *sound* limb, and adapt it to the length of this, by moving the foot-board and sliding brass plate, so as to lengthen or shorten the instrument as the case may require. The foot-board should be so placed, that the heel of the foot may nearly touch the sole of the shoe appended to it. Then, as the limb lies upon the apparatus, and as the apparatus is being brought up firmly against the back of the leg by an assistant, with the angle opposite the knee-joint, the sliding plate should be fixed just anterior to the tuberosity of the ischium, or in other words, that situation which would be considered, were the body in the erect position, immediately below it.

Mode of padding.

Having adapted the apparatus to the length of the sound limb, the surgeon should superintend the construction of a pad to lie upon the apparatus. This should be made of thick coarse flannel.* The number of layers to make a proper pad, must of course depend upon the thickness of the flannel. If what is called coarse house-flannel be employed, from six to eight layers will be required; if thick blanket flannel, not more than about five or six layers will be necessary. I scarcely need mention that the pad should be neatly covered with soft linen or soft calico, in such a manner that no seams may come in contact with the skin of the patient. I might observe, that I never make use of tow or wadding for common pads. These materials shift their situation, get lumpy, and produce irregular pressure in certain situations, and do not protect the skin against the influence of the apparatus where partial pressure is required. They serve well enough, however, as adjuncts to the principal pads, for the purpose of filling up hollows, rounding angles, &c. Near the upper end of the pad should be fixed two pieces of tape. These are tied round the bars of the brass plate (*i, i, Fig.* 2, page 335), so as to confine the end of the pad over the end of this plate. If this precaution be neglected, the pad soon shifts from its proper situation, and the integuments covering the tuberosity of the ischium become left to the pressure of the bare end of the brass plate, which in a short time produces a degree of inconvenience not easily borne by the patient.

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* For hospital practice I have recommended the use of the old rugs instead of flannel. These answer as well as the flannel. The number of layers must be regulated by the thickness of the rugs.

I have seen the skin ulcerated from this cause, which of course is a great evil, as the patient can with difficulty bear the pressure of the upper end of the apparatus after this has taken place.

Again adjusted with the pad.

The apparatus with the pad confined upon it, should be again placed under the *sound* limb, and drawn down with the limb upon it as before. This will enable the surgeon to ascertain any little alteration which the thickness of the pad may render it necessary to make in the situation of the sliding-plate, or the foot-board. Great care should be taken in fixing these parts of the apparatus properly, for the result of the case will much depend upon the accuracy with which the apparatus is adapted to the length of the sound limb. When it is well adapted to the sound limb, it is sure to answer for that which is injured, the natural length of the two limbs being the same.

We should always remember that the thigh-part of the apparatus is to support the back of the thigh, and at the same time to prevent retraction, which it does by resisting the action of the muscles till the union is completed. The apparatus acts as a temporary bone, one part resting against the tuberosity of the ischium, and the other against the back of the leg; but, in order that it may produce this effect, it must be regulated with great care.

Introduction of wadding.

The apparatus having been bent to a proper angle and adapted to the natural length of the limb, the surgeon should notice the form of the calf of the leg and of the thigh; and if it should appear to him that the hollowed part of the leg-piece is too deep for the calf of the leg to lie easy when it becomes a little flattened, which it always does during the continuance of the pressure, he should place some wadding or tow between the pad and the apparatus, *not* between the pad and the limb; he should also place a layer between the pad and the thigh-part of the apparatus, varying in thickness according to the muscularity or thickness of the thigh. The object of this is to support the back of the femur, so as to maintain its natural arched form, and to assist in rounding the angle of the apparatus, so that the limb may rest easily upon it. If it should not appear requisite to place any wadding or tow to fill up the hollow for the calf of the leg, a little should always be put between the pad and the upper end of the leg-piece, in order to assist in rounding the angle formed by the leg and thigh-pieces, and to prevent the integuments covering the bicepital process of the fibula from receiving undue pressure.

Pain at the back of the knee.

When called to patients who have had this apparatus applied by others, I frequently observe that they complain of pain at the back of the knee, just where the limb rests upon the angle of the instrument. This is an evil which always arises from inattention to padding, as the following case will serve to illustrate.

Case.

A boy about 17 years of age, had a fracture of the middle of the femur, for the management of which my apparatus was employed. The boy complained a good deal of the inconvenience which he experienced in the ham, during the early part of the treatment. When the bone was united, and the apparatus removed, it was found that the skin of the ham was ulcerated in several places. About a week after the apparatus was removed, the boy unfortunately broke the femur again in the same place. I had now the application of the apparatus, and I found, when it was properly padded, that the limb lay easily upon it, notwithstanding the existence of the sores. The sores were dressed daily without disturbing the limb; and when the apparatus was again removed, they were nearly, if not quite healed.

A little care taken in padding the leg and thigh-part of the apparatus with wadding or tow, placed under the common pad, close up to the angle, (not over it,) so as to round it, and enlarge the surface for the knee to rest upon, will prevent the occurrence of such mischief.

Mode of applying the apparatus.

When the apparatus and the splints which are used with it for fractures of the femur, are properly padded, the surgeon may place the pelvis-strap between the bars and the plate of the sliding portion, and commence the application, *(see Fig.* 4, p. 348*)*, taking care, however, previously to bandage the limb neatly with a common roller, from the toes to the knee: this having been done, an assistant should take the small of the leg in one hand, and place the other under the knee, and then gradually raise the limb, and at the same time keep the knee bent and the thigh extended. When this is managed adroitly, the patient suffers very little pain. If the limb be lying upon the side, the assistant should gradually turn it round upon the heel, and the patient should, at the same

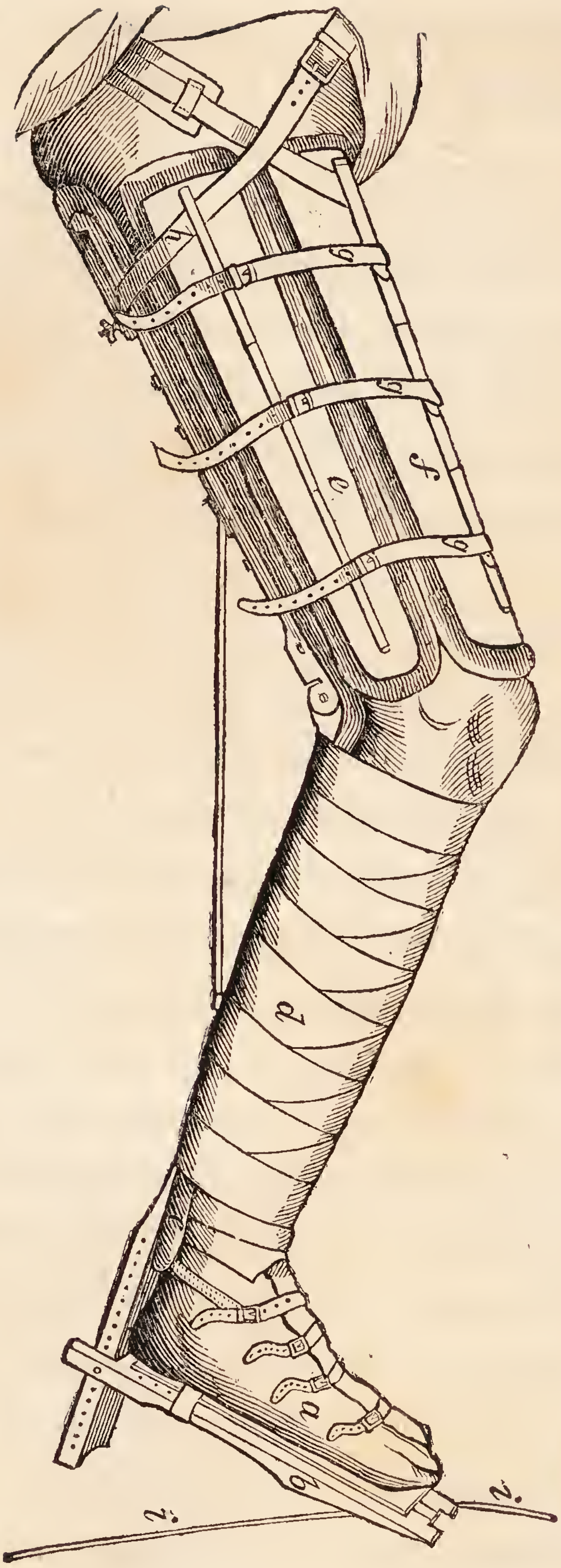

Fig. 4.

time, place himself upon the back. When the limb is raised sufficiently, and brought into a proper direction, the surgeon should place the apparatus under it, and then desire the assistant to lower the limb, and lay it upon the apparatus, placing the foot in the shoe, which should have a pad of flannel, covered with soft linen on the inside of the heel, for the heel of the foot to rest upon. The pad for the heel of the shoe, and also those for the short splints, I make about two-thirds of the thickness of the long pad which lies upon the planes of the apparatus. The shoe, *a*, should now be confined over the instep comfortably close, and regulated so as to support the weight of the foot. The foot-board, *b*, and leg-piece should be placed nearly at a right angle, in order to keep the foot steadily at an easy degree of flexion. Sometimes I apply the shoe before the limb is placed upon the apparatus: this, however, in fractures of the thigh, is a matter of little consequence.

When the foot is secured to the foot-board, our next point is to give equal support to the leg, and fix it to the leg-part of the apparatus. In order to make the bearing regular from the knee to the foot, I place some wadding, *c*, under the small of the leg, between the long pad and the apparatus; the quantity of which, should of course, be regulated according to the thickness of the calf, and length of the heel. The leg might be properly confined to the leg-part of the apparatus, either by a bit of common splint padded, and confined upon the front of the leg with a couple of straps, carried round the limb over the apparatus, or by a short roller, *d*, carried in a spiral direction round the leg, over the leg-part of the apparatus. I have now generally recourse to the latter method, as that which seems upon the whole the most comfortable to the patient. Thus the leg lies upon a pad moulded to its shape, and is at the same time so securely fixed, that it cannot shift from its proper situation upon the apparatus.

The foot and leg being fixed to the apparatus, our next business is to confine the fractured parts in their natural position. With this view, the assistant should take the apparatus and the knee between his hands, and steadily and gradually extend the thigh in a line with the thigh-part of the apparatus, which is supported by the surgeon close up against the back of the thigh. The extension should be continued till the surgeon finds that the upper end of the apparatus occupies the same situation with respect to the tuberosity of the ischium, which it did when placed upon the *sound* limb. This having been done, the apparatus should be kept in this situation, while the surgeon ascertains that the fractured ends of the bone are brought into proper coaptation, and applies the short splints. The longest of these should *(see* page 335*)*, be placed on the outer side, *e*, and should reach from the top of the trochanter major to the lower part of the outer condyle; the shortest should be placed on the inner side, and should reach from the pubis to the lower part of the inner condyle; and the other, *f*, should lie on the front of the thigh, and extend from a little below the superior anterior spinous process of the ilium, to the base of the patella. The splints being adapted, the whole should be secured by straps *g*, *g*, *g*, fixed to the back of the apparatus. The pelvis-strap, *h*, should now be carried round the limb under the strips of leather, on the backs of the short splints, and made to cross on the outer side, and then the *buckle-end* with the sliding-pad should be carried round the pelvis, and made to meet the other end in front, where it should be buckled.

Review of the application.

The surgeon has now the whole limb under his command, and he should see that every part of the apparatus is adjusted with great nicety. He should again notice the situation of the upper end of the apparatus, and, if it should have moved from its proper bearing upon the tuberosity of the ischium, during the buckling of the straps, he should again replace it. He should observe that the short splints are so fixed, that they cannot move from their proper situation. In order to guard against this evil, it is better to give some of the short straps a twist round the leathers fixed upon the backs of the splints.

Time for applying the apparatus.

The limb may be secured in this way as soon as the inflammation arising from the injury is sufficiently got under, which is usually in the course of three or four days. Previous to this period, the front splint should be omitted, and the other two short splints should be confined upon the limb, by means of a roller carried round the limb, over them and the apparatus. The object of this difference in the mode of supporting the limb, is to allow of the application of evaporating lotions, &c. during the first two or three days, or as long as the condition of the soft parts may require. During the continuance of such applications, the patient should lie upon his back, and the limb should be supported in that position which is termed "upon the heel," or flat upon the outer side.

Position.

When all the splints are applied, and the straps are firmly buckled, so that the fractured ends cannot become displaced either in the lateral or longitudinal direction, the surgeon may alter the position of the limb from the heel to the side, or from the side to the heel. But the limb should not be allowed to continue upon the side. Half way between the side and the heel is a better position for a continuance. I generally place the limb upon the heel, or a very little rolled outward. The limb is maintained in either of these positions by means of pillows, assisted by a couple of tapes, *i, i, Fig.* 4, carried from the lower end of the apparatus to the foot of the bed. There is occasionally some advantage in placing the limb in a position a little inclined outwards, especially in persons whose skin is thin, and very easily irritated. In such persons, the pelvis-strap, when strained to the necessary degree of tightness to keep the thigh-part of the apparatus close up against the back of the thigh, presses harder than can be borne without inconvenience, when the limb is kept altogether upon the heel. If the limb is a little rolled outward, and supported by pillows, a portion of the weight is thrown upon the pillows, and consequently the pressure of the pelvis-strap is diminished. When this position is resorted to, the patient may turn round a little upon the side, or rest upon his back, without any danger of disturbing the proper coaptation of the different portions of the bone. He may indeed, if careful, and not likely to exceed any liberty that might be given to him, be permitted to move the limb passively himself from the heel to the side and from the side to the heel at pleasure, when the fracture is transverse or nearly so, and not attended with much laceration of the soft parts; but the surgeon must be on his guard, that he does not give this liberty to any person in whom he has not the greatest confidence. Some surgeons may suppose that the privilege of moving the limb is too great to be intrusted to any patient, and one which must often be followed by unfavourable consequences. It would be folly to argue upon the propriety of giving so great a liberty to patients generally; but, when the individual is trustworthy, and the fracture is of the description I have stated, I believe it might be done with impunity, as the following cases will serve to shew.

A healthy man, æt. 20, in St. Thomas's Hospital, under Mr. Green, had a transverse fracture of the thigh, extending through the middle third, produced by the wheel of a waggon as it passed over the limb. Two days after the accident, my apparatus was applied with three short splints upon the thigh, in the manner I have directed, and I desired the man to place his limb in any position most comfortable to himself, and to alter it at pleasure either from the heel to the side, or from the side to the heel, taking care to turn the body at the same time. He was desired to move the limb by means of his hands, as he lay in the horizontal position, and not by exerting the muscles attached to it. He was also directed to have his bed made every other day; for this purpose he was carefully lifted out of bed in the horizontal position, and placed upon the next bed or on the floor. This line of treatment was continued for a month, at the expiration of which the bone was found united. He continued, however, to wear the apparatus another week. The fracture united without retraction or other deformity, and the limb was so strong at the expiration of six weeks from the time of the accident, that the man was able to walk without the aid of crutches or any other assistance. Case.

Case.

A healthy man, æt. 26, in St. Thomas's Hospital, was placed under my care by Mr. Travers, having a simple transverse fracture of the femur across the middle. The injury was occasioned by the wheel of a cart, which passed over the limb at the seat of fracture. The soft parts were much bruised, and considerable tension followed the accident.

The apparatus was applied on the fourth day after the accident, and he had his bed made as soon as it was properly adjusted, which was repeated during the uniting process as often as he wished. He was allowed to place his limb in any position most congenial to his feelings, either on the heel or on the side, and to alter the position at pleasure.

The uniting process went on very favourably. The instrument was removed at the end of the fifth week, and at the expiration of the sixth, the man was able to walk the ward without crutch or stick.

He has since informed me, that the limb was so strong as the end of *ten weeks* after the accident, that he actually carried a sack of malt the distance of fifteen yards, without experiencing any injurious consequence.

Attention necessary during the use of the apparatus.

During the uniting process, the surgeon should attend to three points particularly, *viz.*, he must take care that the instrument does not ride over the tuberosity of the ischium; he must take care that the circular straps are kept closely buckled; and that the patient does not move the limb by the exertion of its own muscles. The reason of these three directions will immediately appear. The riding of the instrument indicates that the fractured ends of the bone overlap, and if they be permitted to remain, they will unite in this unnatural position, and the consequence will be a shortened limb. If the circular straps be not kept closely buckled, the fractured ends may become displaced in the transverse direction, and if they unite while so displaced, what I call angular deformity of the femur, will be the result. If the patient wants to have the limb moved, it should be done either by his own hand or by an attendant, always remembering that whatever motion is given to the limb, should be gentle and entirely passive. He should never raise it himself from the bed, but simply roll it as it were upon a pivot. If the patient attempts to move the limb by its own powers, he will incur the danger of displacing the upper portion of the bone; for the muscles, which lie as cushions between the splints and the bone, have but little influence in preventing the effects of those whose action may tend to produce displacement. I am therefore of opinion, that such a practice should never be allowed. I do not say that the exertion of the muscles inserted into the bone, sufficiently to move the fractured limb, would be absolutely followed by want of union, or by deformity of the limb, on the contrary I know it might sometimes be done without the occurrence of any apparent injury. A man in St. Thomas's Hospital, put the powers of the apparatus in holding the fractured parts in proper apposition, under such circumstances, strongly to the test.

Case.

This man was 60 years of age. He was admitted under the care of Mr. Green, on the 4th of July, 1823, with a fracture of the right femur, situated at the upper part of the middle third. The fracture was produced by a butt of beer, which pushed him backward and fell upon him as he lay upon the ground. Boyer's apparatus and short splints, were applied the same day four or five hours after the accident, and were worn with difficulty for sixteen days, the man frequently complaining of much pain.

On the eighteenth day, I superintended the application of my apparatus by Mr. Green's request. The fracture was at this time quite loose, and the fractured ends displaced. As soon as the apparatus was properly adjusted, he said the limb felt strong, and he apparently experienced considerable pleasure in giving us occular proof of his assertion; for, notwithstanding we strictly enjoined him to keep the limb quiet, he frequently moved it from the heel to the side, and from the side to the heel, with as little ceremony as if the bone had been entire. This he did without any assistance, merely by the action of the muscles of the limb. I several times saw him sitting upon the edge of the bed using the bed-pan, and when I remonstrated with him upon the impropriety of his conduct, he told me that he could not use the bed-pan in the horizontal posture, and as no one would help him out of bed, he was obliged to get out himself.

I felt much anxiety about this case, fearing the bone would not unite; but, contrary, I believe, to the expectation of all present, it was found, when the apparatus was removed on the 30th of September, a period little more than two months from the time of its first application, that the bone was consolidated with a superabundance of callus, and no shortening or deformity had taken place.

This man was in his dotage, which is sufficient to account for his inattention to the directions that were given to him. The bone providentially united, but I cannot suppose that the practice indicated by the favourable result of the case, could be generally followed with impunity.

Oblique fractures.

With respect to oblique fractures of the middle third, which are far more common than transverse, I may make a few additional remarks, as they require more attention in the treatment; but this attention is to be given more to the employment of additional padding than to any other circumstance in the application of the apparatus. This must be introduced so as to suit the particular case in hand. If the fracture extends downward and outward, the surgeon should take care to pad his lateral splints in such a way as to make them press rather more firmly upon the inner side of the lower portion of the bone, and upon the outer side of the upper portion, than upon any other part. By this simple management, the fractured surfaces are kept closely applied to each other. Should the surgeon incautiously pad the splints in such a manner as to produce the greater pressure upon the *outer* side of the lower portion of the bone, and upon the inner side of the upper portion, in a case of the description I have mentioned, it must be evident that he would cause his lateral splints to act upon the two portions of bone, so as to keep the fractured surfaces asunder; and the *least* evil he could expect under such circumstances, would be a very tardy union, and most probably he would produce no union by the intervention of callus. The principle here inculcated, applies not only to fractures extending downward and outward, but to all other oblique fractures of this part of the femur. We should consider the direction which the fracture takes through the bone, and adapt our pressure, so as to keep the fractured surfaces in close apposition. If this and the other directions I have mentioned, as necessary to be observed in the management of transvere fractures, be properly attended to in the treatment of those which are oblique, the fractured ends will unite in their natural position, the limb will be found free from deformity, and its powers and flexibility will be speedily restored.

Case.

Mr. T. æt. 81, fell as he was getting off a coach, and fractured his left femur across the middle. The fracture was oblique, and attended with sufficient laceration of the soft parts to allow the lower portion to become retracted two inches and a half, measuring from the superior anterior spinous process of the ilium to the base of the patella.

The apparatus was applied, and he was allowed to have the limb moved occasionally from one position to another, and to have his bed made every two or three days. This was done without producing any pain or sensation of motion in the fracture. Eight weeks after the accident, the apparatus was removed and discontinued, as accurate union had taken place.

Case.

John Murphy, æt. 41, a patient of Mr. Green's, in St. Thomas's Hospital, had a very loose fracture of the femur, produced by a violent blow against a wheel. The fracture was situated at the lower end of the middle third, and extended through the bone obliquely downward and outward. I found the limb lying upon a pillow, much distorted and swollen, and shortened about two inches.* The fractured end of the lower portion was drawn up along the inner side of that of the upper portion, which projected strongly against the soft parts at the outer side of the thigh.

The limb was put up lightly in my apparatus the day after the accident, and kept in the bent position upon the heel. The straps attached to the apparatus, were gradually tightened as the tumefaction subsided. The use of the apparatus was discontinued at the end of five weeks after the accident, as consolidation of the bone had taken place. The limb was however, discovered to be a quarter of an inch shorter than the opposite, but there was no other displacement observable, and this in the course of a short time was not felt in the act of progression. The foot was in its proper position, and the form of the limb appeared to be in every respect quite natural. After the union was completed, he soon recovered the free use of the limb.

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* The limb being greatly enlarged, the degree of overlapping of the fractured ends could not be ascertained correctly; the measure indicated it to be about two inches, but from the appearance of the limb, it was considerably more.

Fractures of the lower third of the femur—observations.

The treatment of fractures of the lower third of the femur, has been considered very difficult, and in truth, I believe it is, when conducted with any of the contrivances commonly employed, for I have never yet seen a single example of fracture in this situation, where the adoption of these contrivances was not followed by considerable deformity of the limb. Sir Astley Cooper, speaking of oblique fractures of the femur just above the condyles, says, "This is a most formidable injury as regards the consequences which it produces on the future form and use of the limb, for they are liable to terminate most unfortunately, by producing deformity and preventing the flexion of the knee-joint." It would seem that surgeons have not only made use of means incapable of supporting the fractured parts in their proper apposition, but they have failed to investigate these injuries sufficiently to understand their nature. Even our illustrious countryman, Sir Astley Cooper, who is understood to be constantly seeking after facts upon which to found his practice, speaks of oblique fractures above the condyles in such a manner as would lead his readers to suppose that the bone is always broken in the same direction, and that the upper portion always penetrates the rectus muscle. In his Treatise on Dislocations and Fractures of the Joints, *(Ed.* 1, page 226), he says, "It is only of late years that I have had an opportunity of investigating this case by dissection, and consequently of obtaining any exact knowledge of the nature of the injury. The appearances which the accident produces is, that the lower and broken extremity of the shaft of the bone projects and forms a sharp point just above the patella, which pierces the rectus muscle, threatens to tear the skin, and sometimes does so; whilst the patella, tibia, and condyles of the os femoris sink into the ham, and are drawn upwards behind the broken extremity of the shaft of the os femoris." Again, page 235, speaking of the treatment of this injury, he observes, "The leg is to be first bent, to draw the rectus muscle over the broken extremity of the bone." I do not know what other inferences can be drawn from Sir Astley's observations, but that the fracture is always of that description, which I have called downward and forward, or nearly in this line, and that the rectus muscle is invariably pierced. If I am right in these conclusions, it will appear that Sir Astley was not acquainted with the varieties of the accident, the nature of which he thought he had discovered. According to my observation, the bone is divided in different directions which are for the most part easily distinguished from one another, and each variety is usually attended by consequences peculiar to itself. Sir Astley made out one of these, and as far I understand him, came to the conclusion, that all oblique fractures in this situation are of the description of which he speaks. This will be found very far from correct.

The following cases extracted from Sir A. C.'s work, will show the difficulty which has been experienced in managing oblique fractures of the femur near the condyles by the common modes of treatment; and they are certainly good samples of what I have myself repeatedly observed under the operation of those contrivances which are usually adopted.

Case.

Mr. Kidd, who weighed fifteen stone, on the 9th of November, 1819, fell from the height of twenty-one feet, upon his feet, and broke his thigh-bone just above the knee by the severity of the concussion. The fracture was situated immediately above the condyles, and the broken extremity of the shaft of the bone appeared through the integuments and rectus muscle just above the patella. He was immediately carried home, and I saw him with Mr. Phillips, surgeon to the King's household, a short time after the accident. We agreed that the projecting extremity of the thigh-bone should be immediately sawn off, and that the edges of the wound should be approximated, so as to render the fracture simple; and this was immediately done. The limb was placed upon the double-inclined plane, the wound healed without difficulty, and our first object was thus accomplished. On the 30th of November, splints were applied in order to press the bones firmly together. On December 23, the leg was straightened, and the inclined plane was lowered so as to bring the limb gradually into a straight position. On February 2d, he sat up in bed; on the 7th of February, the knee having been moved, the fractured bones appeared to separate, and on the 14th it was clearly ascertained that the bone was not united. On the 16th, a leather bandage with many straps, was tightly bound round the knee, having previously tried the position upon his side, which only led to a greater separation of the bone; he was therefore again placed upon his back. On the 3d of May (about twenty-five weeks after the accident) the bone was found to be united, and on the 12th the leather bandage was removed, and the limb placed on a pillow. On the 10th of July, he moved from one side of the bed to the other with difficulty and on the 16th was placed on another bed, which was obliged to be adjusted to the exact level with the other before his removal could be accomplished. On July the 19th, he was removed from London to Kensington on a litter. On the 8th of August, the thigh was fomented in order to remove the excessive bulk it had acquired, and to diminish its hardness, but it was discontinued on the 14th, because it was found to increase the swelling. On the 15th, the leg was bathed with the liquor plumbi subacetatis dilutus and spirits of wine, the skin having been ulcerated from the time that the bandage was buckled tight around the knee. On October the 24th, the leg was placed in a gout-cradle. On the 16th he was on a sofa for two hours, but on the 28th, was obliged to keep in bed, because irritation and swelling had been produced by moving on the two preceding days. On November the 3d, he was wheeled into another room on a chair. On January 29th, 1822, he was, for the first time, on crutches; and on February 24th, being about two years and three months after the accident, he first walked out of doors.

His present state, March, 1822, is as follows. The bone above the knee is excessively enlarged; the patella is fixed below the broken extremity of the shaft of the bone, the point of which adheres to the skin.

Mr. Kidd possessed a very fine constitution, for his pulse after the accident never exceeded 63, and although the rectus muscle was penetrated by the bone, he never complained of any spasmodic contraction of the limb."—Page 228.

The injury in this case having been reduced to the state of a simple fracture so soon after the accident, it must be regarded in all its future stages, as going on as if the fracture had been originally simple, as in the following case, which Sir Astley Cooper attended with Mr. Welbank.—Page 231.

"Mr. ——, of middle age, muscular and tall, was driving, on the morning of the 20th of July 1821, in the neighbourhood of Leicester Fields, Case.

and was thrown forward out of his gig over the horse, which had fallen. It is probable the external condyle of the right femur received the force and weight of his descent upon the pavement. He was brought from Leicester Fields to Chancery-lane in a coach, with his legs out of the door, no surgical assistance having been yet procured. When first seen by his surgical attendant, he was lying upon his back on the bed, with the right leg bent, and lying across the middle of the left leg at an angle. There was an appearance resembling the lateral dislocation of the knee, from a deep hollow close to the joint, and on its external or fibular side an abrupt and sharp projection of bone was distinctly observable. Slight extension replaced the parts, and it now appear that the thigh had, previously to the reduction, been bent inwards over the left, upon an oblique fracture, situated close to the patella. The patella itself was very obscurely felt through a circumscribed effusion in front of the joint. Just above the situation of its upper edge, might still be traced the ridge of the fracture, a slight groove intervening; the appearance, indeed, at this and later periods of the accident, might have been mistaken with superficial examination for the transverse fracture of the patella.

Flexion produced great projection of the upper part of the femur, and extension readily restored the natural appearance, except in the swelling in the front of the patella. The crepitus was very indistinct, if at all observable.

“ Little more was done during the first week, than steadying the joint in the extended position with short splints, and subduing the inflammation of the capsule, which supervened. After this period, a long splint was applied from the trochanter major to the outside of the foot, and an opposing short splint from the middle of the femur to the middle of the inside of the leg, and firmly confined by tapes and buckles. The whole limb was supported upon an inclined plane, and flexion cautiously obviated. To prevent motion of the pelvis, the stools were removed in napkins. The posture was not, however, steadily maintained ; and, it was frequently found that the upper point of bone varied in its degree of projection, and at different times more or less encroached on the situation of the upper edge of the patella. To remedy this, slight permanent extension, with weights appended to the foot were adopted with advantage ; though I believe that the position was by no means regularly maintained, for I have since understood that the patient not unfrequently even had his back washed. The ridge of the upper portion of the femur appeared to project so slightly, that it was deemed better to insure union, than to add to the frequency of disturbance, by being too solicitous of exact apposition.

" About September the 7th, the bone was thought sufficiently united, but flexion was neither attempted by the surgeon, nor permitted to the patient. On September the 10th, the patient was removed to Eastbury, Herts, in a litter-carriage, as his health was suffering, the limb being steadied with splints, and (the) position resumed during the journey. In removing from one bed to another, and in other alterations of posture, it was obvious that flexion produced a greater appearance of projection of the femur than had been anticipated. This might be referred to drawing or rather sinking of the patella in flexion, and indeed it could, to appearance, be nearly remedied by elevating the leg upon the thigh, as in extension. Under these circumstances, however, rest in the extended posture was again adopted for a fortnight. About September 25th, a second examination decided the necessity for further rest, as the increase of projection on flexion of the knee and a slight lateral motion induced a belief of infirm union. It is worthy of mention, that the immediate vicinity of the joint, the mobility of the patella, and the general thickening, rendered all examinations of extreme difficulty and uncertainty. A circular belt was tightly girded upon the situation of the injury, with a view of compressing the fracture, and maintaining the parts in firm apposition. October 16th, the union was considered complete, and the patient was allowed to get up. On November the 1st, he resumed his professional duties as an advocate. For a considerable period he suffered pain and swelling of the limb, but has gradually and slowly improved.

"May, 1822. At this date he can walk about his room, without the assistance either of crutch or stick. He has little power of flexion at the knee-joint. The joint is, however, apparently moveable to a certain extent beneath the patella, which bone is fixed beneath the projecting edge of the upper portion of the femur, which evidently overlaps and displaces it. There is visible shortening of the limb, and the contour of the thigh is somewhat bowed outward."

Remarks.

The degree of shortening which took place in these two cases is not mentioned, but, judging from the nature of the union, there is reason to suppose that this was considerable in both. In order to obviate the evils which are noticed in these two cases, Sir Astley recommends us to keep the limb extended in the straight position with his modification of Boyer's splint, mentioned in a former section; a mode of treatment which, with all due deference to this eminent surgeon, I will venture to assert, will not be found productive of those beneficial effects which he seems to anticipate.

Author's treatment.

I shall now proceed to mention that plan of treatment which I have found the best in the management of fractures of the lower third of the femur, which, under the usual modes of treatment, are for the most part, as in the two preceding cases, followed by most direful consequences to the patient.

I employ in the treatment of all simple fractures of the lower third of the femur, the apparatus which I have recommended for fractures which occur in the middle third. The only difference in the application consists in fixing the leg and thigh-pieces together at a sharper angle than is necessary for fractures of the middle third of the bone. This difference in the angle of the apparatus is made with a view to relax the gastrocnemius and popliteus muscles more than is required when the fracture is situated at a greater distance from the condyles. This might be regarded as a general rule, applicable to all those oblique and transverse fractures which occur immediately above the condyles. It might be observed, however, that when the fracture divides the bone in a direction downward and backward, it is not necessary to fix the apparatus at a more acute angle, than when the fracture is in the middle of the femur; for, in this variety of fracture, the action of the gastrocnemius and popliteus assists, as has been said, in keeping the fractured surfaces in close apposition, provided the femur be maintained of its proper length. I do not think it advisable to allow the patient to move the limb himself in these cases; for, if the fracture be close to the condyles, the short splints used with the apparatus, may not have a sufficient hold of the lower part to prevent it from moving independently of the upper. The patient, however, may have his bed made as often as is necessary for his comforts, and may have the limb moved passively by an attendant at pleasure.

Transverse fracture—case

A woman, aged 70, in St. Thomas's Hospital, under Mr. Green, had a transverse fracture of the femur, just above the condyles, produced by a fall upon the knee. This person had my apparatus applied, under my direction, shortly after the accident, and wore it for six weeks. The bone was now examined, and found united with the fractured parts in proper apposition.

This woman could bear to have the limb moved freely, and to have her bed made, without suffering any additional inconvenience in the fracture. After the union of the bone was completed, she soon recovered the use of the limb.

Oblique fracture—case.

A woman, æt. 70, was admitted into St. Thomas's Hospital, under the care of Mr. Travers, with a loose fracture of the left femur, extending obliquely downward and forward, just above the condyles, which was occasioned by a fall down stairs. The tumefaction which followed the accident was not very great. The limb was first placed upon the double-inclined plane or common fracture-box, but the fractured ends became much displaced, and the woman suffered greatly in consequence.

On the fifth day, the shortening of the limb was an inch and three-quarters. The lower portion of the bone was turned round, so that the fractured end projected in the ham, while the fractured end of the upper portion formed a considerable prominence at the base of the patella. Mr. Travers now recommended the application of my apparatus, which I assisted in adjusting, in the manner above described. She wore the apparatus six weeks, at the expiration of which the bone was found firmly united, without shortening or deformity of any kind.

This woman had her bed made several times during the uniting process, and, being in her dotage, put the powers of the apparatus to the test in other respects, in a most extraordinary manner. She never remained long in the same position. I found her sometimes on her back, sometimes on one side, and sometimes on the other, and occasionally raised almost to the sitting posture. She frequently moved the limb from side to side, without any regard to the consequences of her imprudence, but the apparatus secured the different parts of the limb so firmly in relation to one another, that, notwithstanding the various movements to which it and the body were so incautiously subjected, I could not discover that she ever felt any motion of the fractured ends of the bone from the time the apparatus was first applied. She recovered the complete use of the limb very rapidly for a person of her age. Before she left the Hospital, she was able to walk without any adventitious assistance, and almost without a limp.

Remark.

It is proper to notice, that this patient walked with considerable eversion of the foot before the accident, which she attributes to a previous injury received in the knee. She can now, however, walk without turning the foot outward, though, when stepping carelessly, she sometimes places the foot upon the ground with the toe everted somewhat more than the opposite.

Case.

A woman, aged 50, was admitted into St. Thomas's Hospital, under Mr. Green, with an oblique fracture of the left femur, extending through the bone downward and outward, commencing about three inches and a half above the condyles. The fracture was occasioned by a fall upon the limb, and was attended with great laceration of the surrounding parts, allowing the broken extremities to overlap nearly three inches. The fractured end of the upper portion projected on the outer side of the knee, The fractured end of the lower portion lay to the inner side of that of the upper, and was drawn considerably backward by the action of the gastrocnemius and popliteus muscles. The limb presented much the appearance which is observed when the tibia is dislocated inward.

My apparatus was applied soon after her admission into the Hospital, but, from some inadvertence on the part of the dresser, not so as to support the injured parts in their natural position. It was re-applied under my superintendance on the fifth day. The swelling of the knee-joint, which was at first considerable, was now speedily reduced by the use of evaporating lotions. She wore the apparatus thirty-six days from the time it was properly adjusted. Its further use was now discontinued, as consolidation of the fractured ends had taken place.

When the parts were accurately examined, it was found that the fractured end of the upper portion could be felt at the outer side of the limb, and there was about the eighth of an inch difference in the length of the two limbs, the left being the shortest. These trifling variations, however, from the natural state, could not be perceived by the eye, nor were they felt in the act of progression.

The woman had the limb moved frequently, and had her bed made without feeling any motion in the fracture, or any additional pain. There was a good deal of stiffness in the knee after the union was accomplished, but this was soon got over without the use of apparatus, and the functions of the limb were completely restored.

Case.

Mr. S. aged 43, had a loose fracture of the left femur, situated a little above the condyles, and extending through the bone obliquely downward and outward. The injury was occasioned by the wheel of a stage-coach, which passed over the limb. The limb was placed in the straight position, and short splints applied very soon after the accident.

I saw Mr. S. on the fifth day; at this time the pain and swelling were considerable, and the shortening was found by careful measurement to be *upwards of two inches and a half.* The fractured end of the upper portion projected at the outer side of the base of the outer condyle, and the fractured end of the lower portion lay to the inner side, and projected considerably backward. My apparatus was now applied, and continued upon the limb for six weeks. At the expiration of this time the limb was examined, and found firmly and accurately united; being of its natural length, and free from deformity of any kind.

At the end of two months after the accident, Mr. S. was able to walk firmly without crutch or other assistance, and with only a slight limp.

Case.

James Worsfold, æt. 28, was brought into St. Thomas's Hospital, in Mr. Green's week, with a very loose oblique fracture of the right femur, extending through the bone downward and outward. The fracture in this case was situated about two inches above the condyles, and was produced by the wheel of a waggon passing over the limb.

I saw this man on the third day after the accident. The limb was swollen much, and shortened nearly three inches. My apparatus was now applied, and great relief was immediately obtained, by freeing the fractured ends from the muscles and bringing them into proper coaptation. He wore the apparatus thirty-three days, during which the limb could be moved passively in any direction without producing motion or other disturbance. The fractured ends were now found accurately united. The limb maintained its natural position and proper length, and speedily became as useful as the other.

The femur is sometimes broken in several places. The following was a case of fracture immediately above the condyles and through the shaft of the bone.

Double fracture—Case.

Sam. Chirchill, æt. 54, was brought into St. Thomas's Hospital, in Mr. Green's week, with a double fracture of the femur. The lower fracture was situated just above the condyles immediately where they join the shaft of the bone, and was nearly transverse; the upper fracture was situated in the middle third. I superintended the application of the apparatus on the third day, and its use was continued for forty days, at the end of which consolidation was completed in both fractures.

The degree of shortening which had taken place before the application of the apparatus was not accurately noted, but when it was taken off, the injured limb was found to have become retracted about a quarter of an inch. This difference is not felt in walking, nor can it be perceived by simply placing the limbs together in the straight position. The natural figure of the limb is well preserved.

The man had his bed made several times during the uniting process, and the limb was frequently moved passively by myself, in order to show the gentlemen at the hospital the operation of the apparatus; but these various movements did not disturb the coaptation of the fractured parts, nor apparently in any way retard the cure.

General inferences.

General Inferences.—1st. The deformity which is known to take place in the union of fractures of the middle and lower thirds of the thigh-bone, is not the necessary result of the physical condition of the injured parts.

2d. The common causes of displacement of the fractured extremities, and consequently of the deformity which supervenes, are the tonic and convulsive action of the muscles, and the influence of gravity and other external forces variously applied.

3d. The contrivances which are commonly used in the treatment of these fractures, do not sufficiently resist the operation of the forces above-mentioned, but suffer their influence to be exerted upon the bone, in all cases more or less injuriously, and at the same time often assist in producing displacement of the fractured ends; so that deformity, differing in kind and degree in different cases, is almost the constant result of fractures of the femur treated by these means.

4th. By the plan of treatment which the author recommends, he feels himself justified in stating, that the usual causes of deformity might be easily overcome, effectually controlled, and a proper coaptation of the broken ends maintained, whether the fracture be transverse or oblique, or situated in the middle or lower thirds; so that, when the apparatus is judiciously managed during the uniting process, consolidation of the bone takes place without the occurrence of shortening of the limb, or any other deformity deserving of particular notice.

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PLATE. 1.

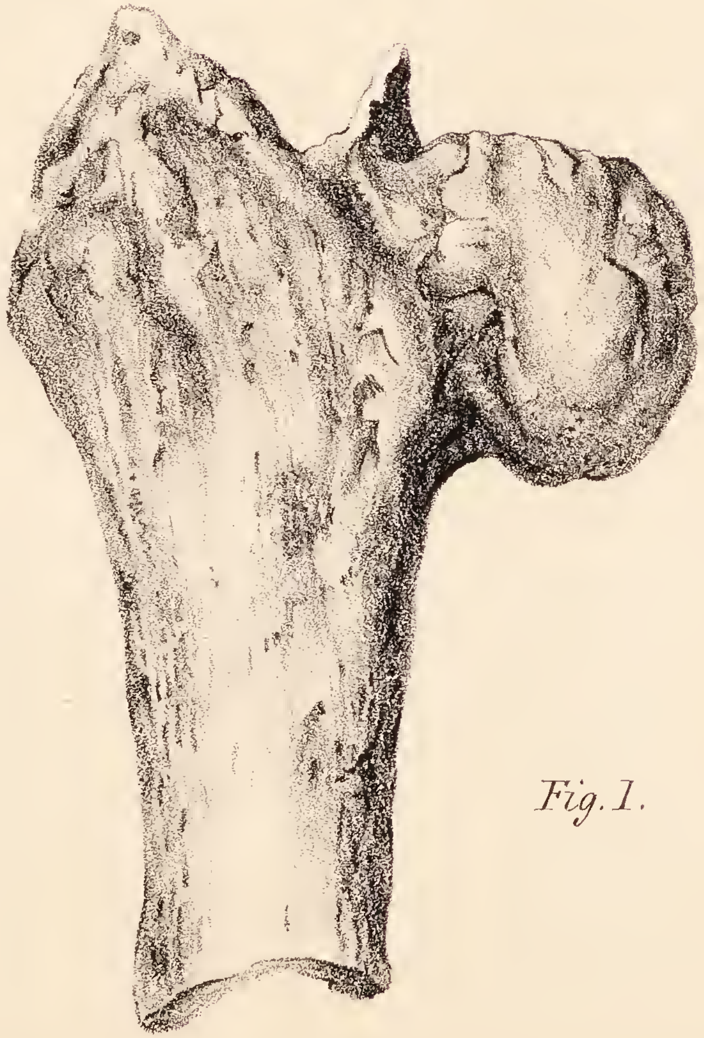

Fig. 1.

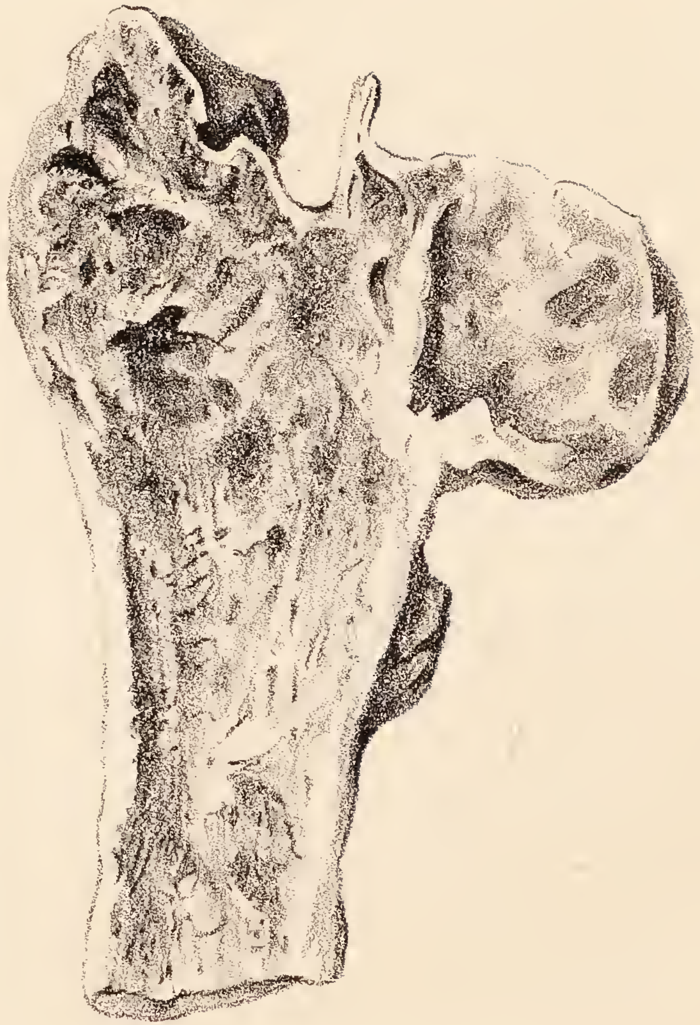

Fig. 2.

PLATE I.

Fig. 1.

Shews the external surface of the upper portion of a thigh-bone, which had been fractured within the capsular ligament, and had united partly by bone and partly by a cartilaginous medium. The neck of the bone was nearly absorbed.

Fig. 2.

Represents the surface made by a perpendicular section of the same bone.

The preparations from which the drawings in this plate were taken are in Mr. Langstaff's collection.

PLATE. II.

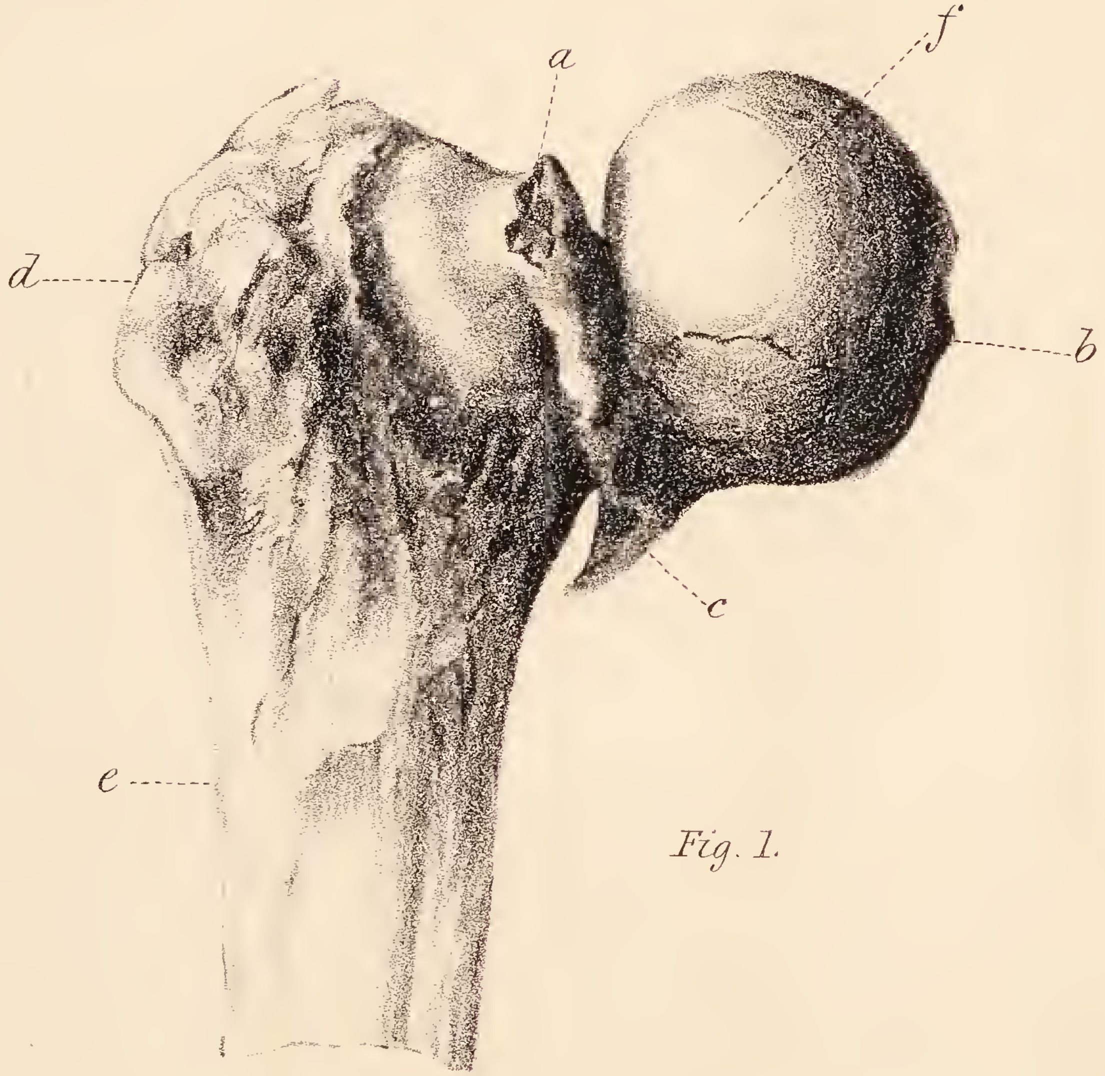

Fig. 1.

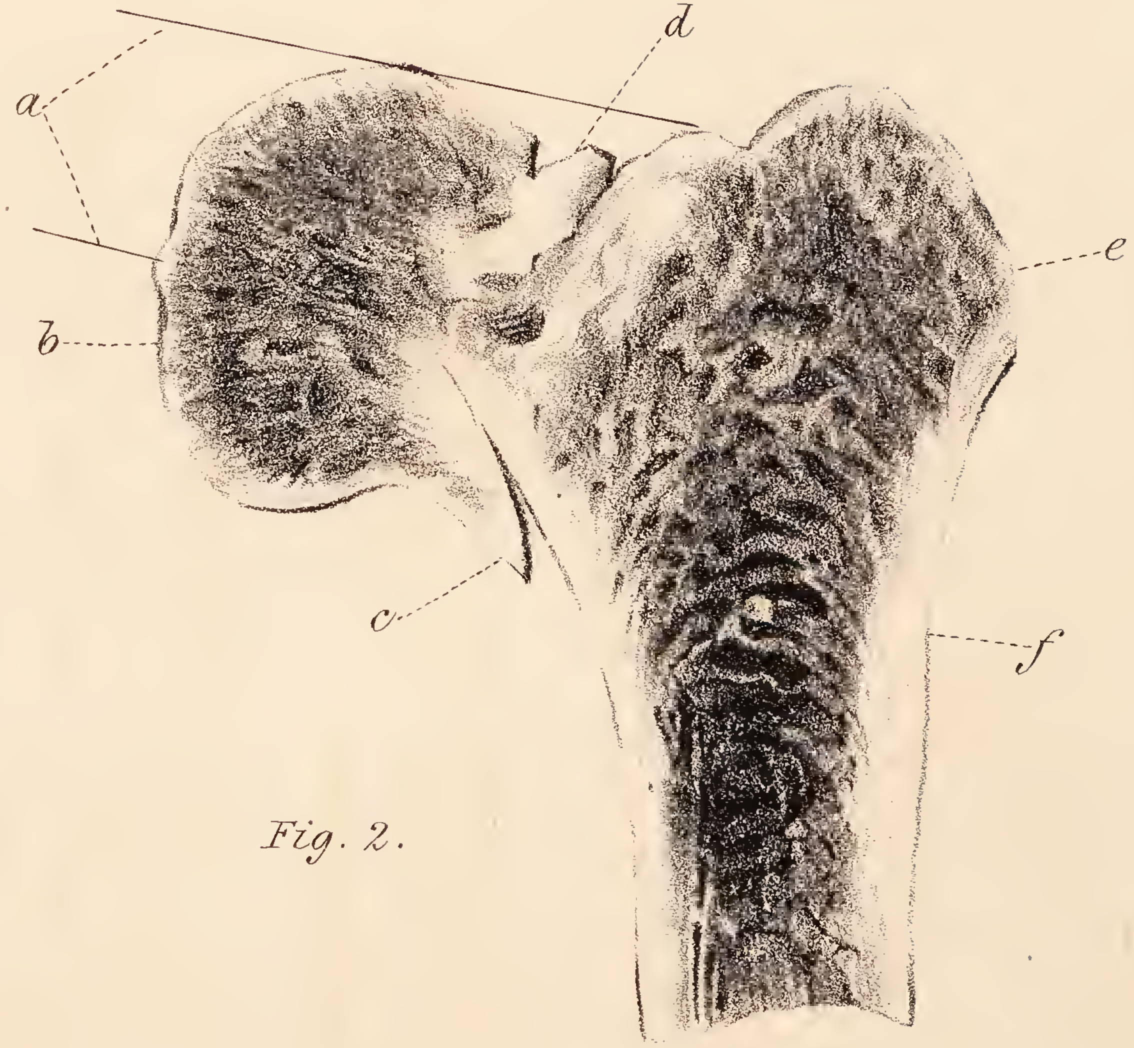

Fig. 2.

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PLATE II.

Fig. 1.

A view of the anterior surface of the upper and external part of the femur, taken from Mr. Chorley's patient.

a, A portion of the shortened cervix.
b, The head of the bone.
c, Part of the shell of the neck, broken off with the head of the bone.
d, The trochanter major.
e, The shaft of the bone.
f, A mark on the head, showing the attachment of an adventitious ligament.

Fig. 2.

A view of the internal surface, made by a perpendicular section of the same bone.

a, The upper and lower lines, connected by the dotted lines, point out the situation of the shell of the upper and lower surface of the trochanteral portion of the neck. The lower line points to a portion of the lower surface of the shell of the neck imbedded in the head of the bone. This part of the cervix probably maintains its natural direction and density.

b, The head of the bone excavated, and receiving a part of the trochanteral portion of the neck.

c, A part of the shell of the neck broken off with the head. This was apparently united, before the accident, with that part which is pointed out by the lower line, *a*, and with it formed the natural oblique line of the lower surface of the neck.

d, The callus, by which consolidation is effected, partly cancellated.

e, The trochanter major.

f, The shaft of the bone.

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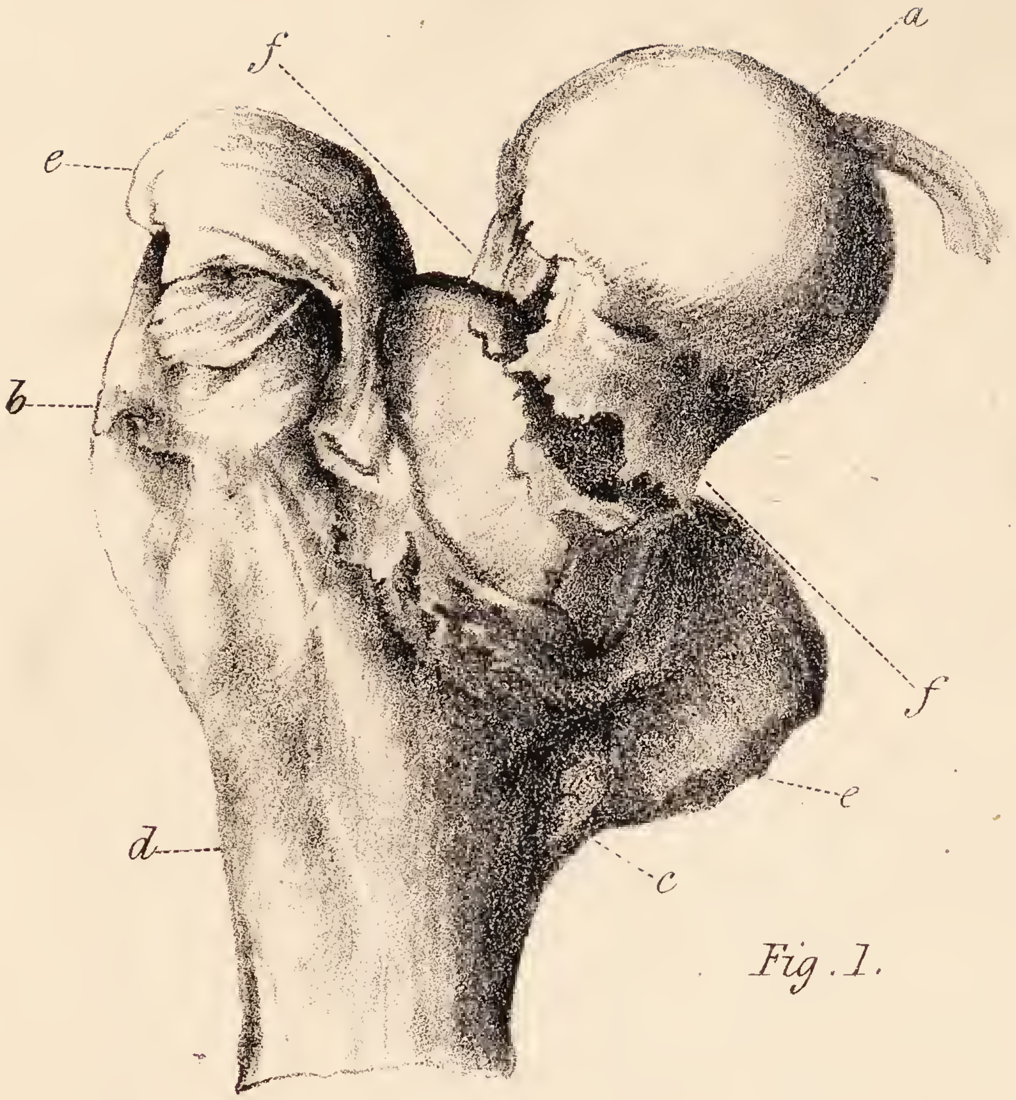

Fig. 1.

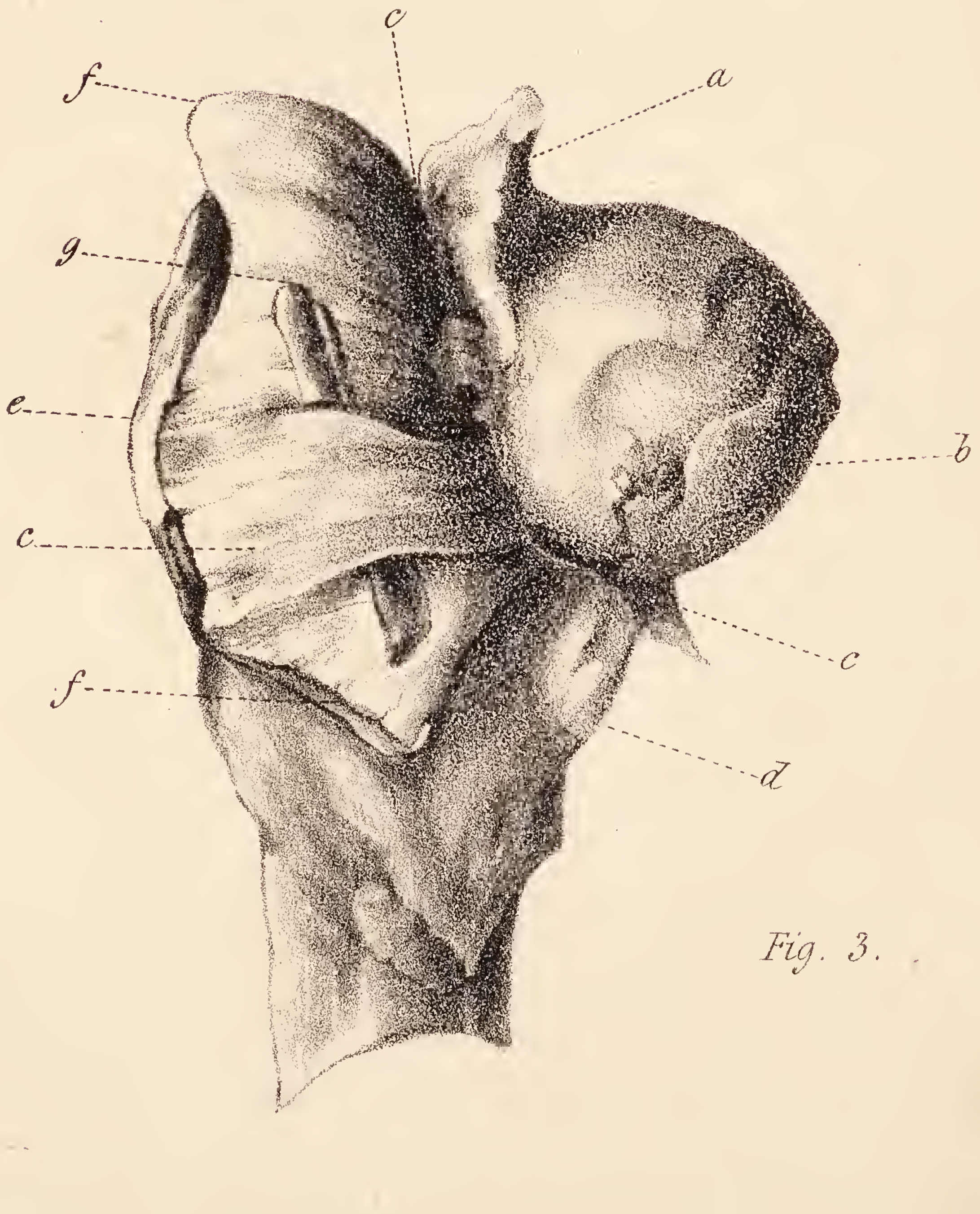

Fig. 3.

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TE. III.

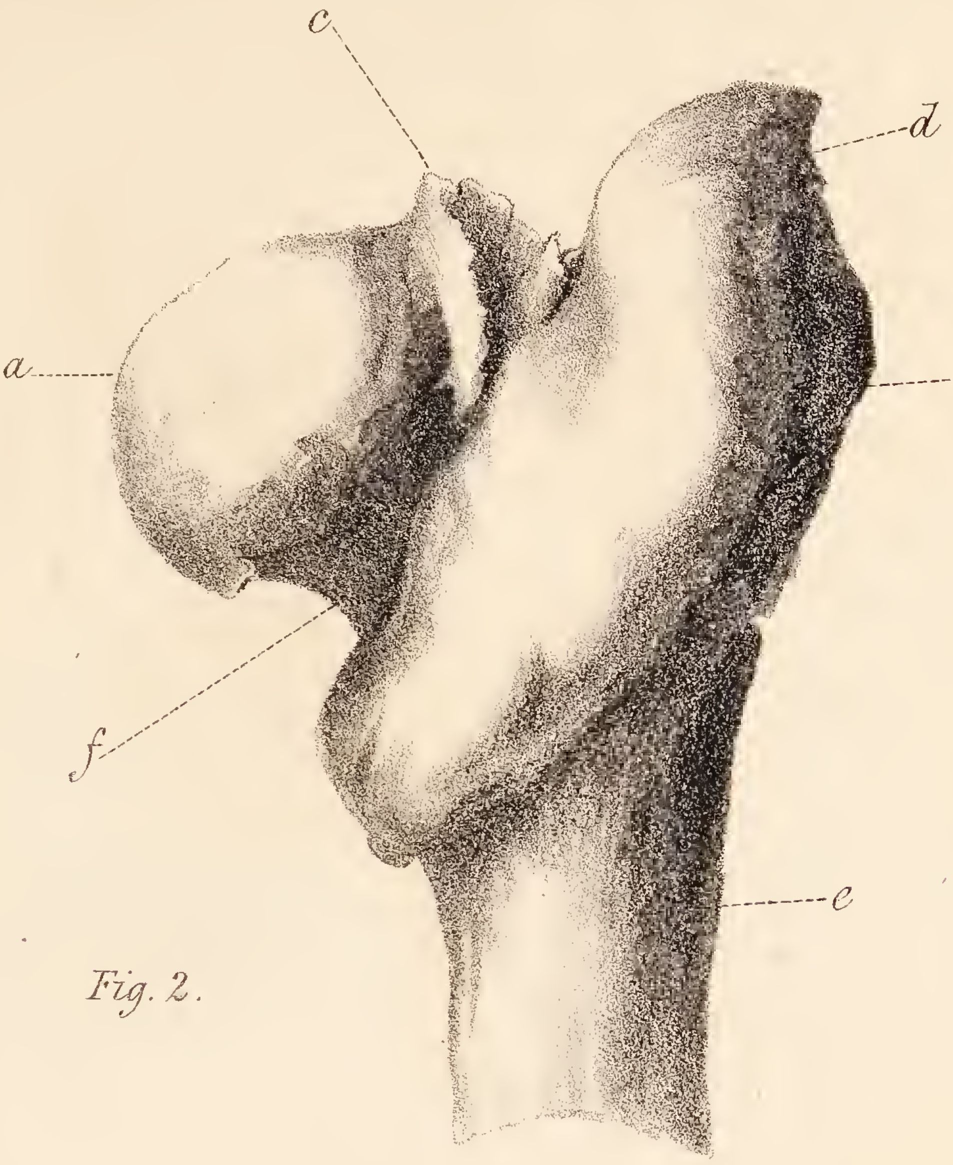


Fig. 2.

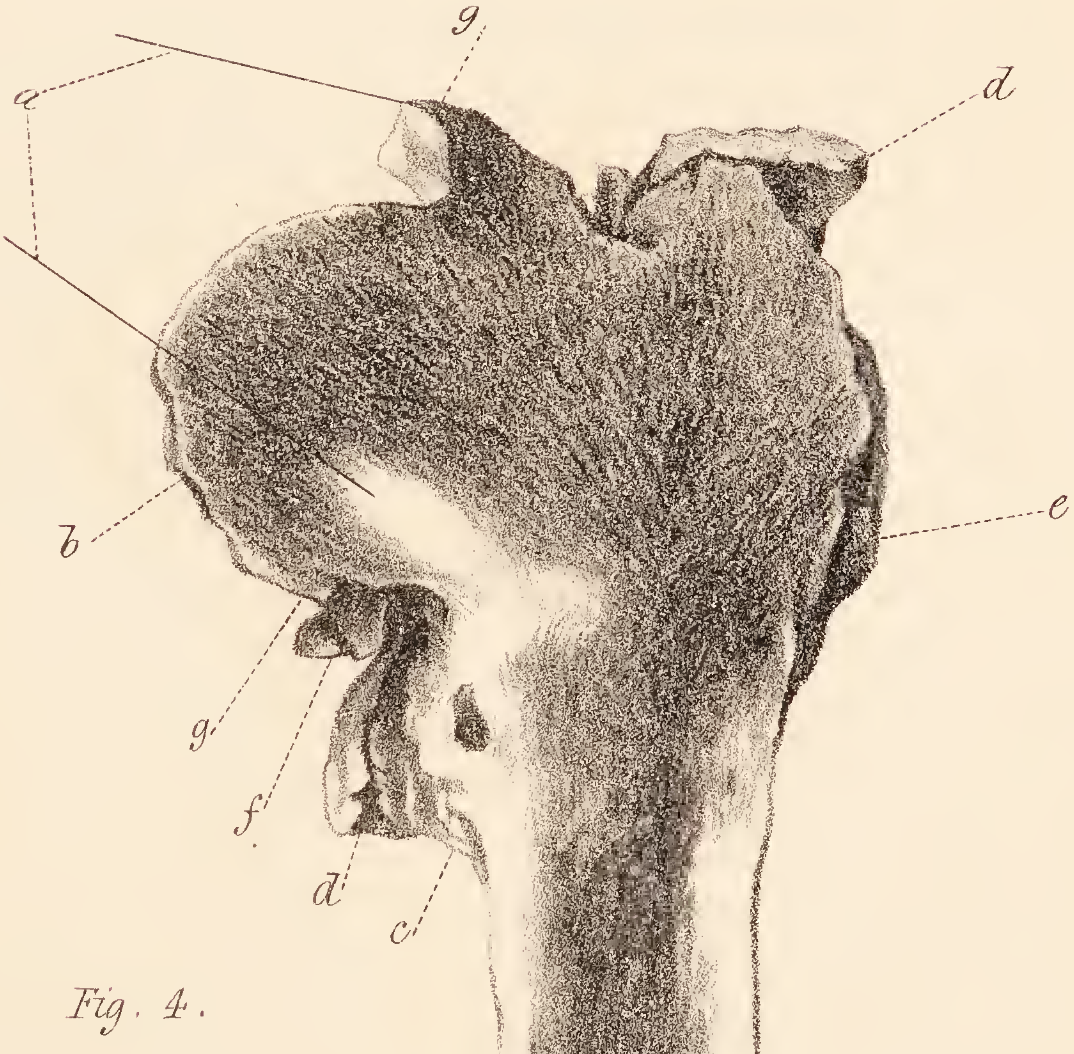


Fig. 4.

fevre, Newman St.

PLATE III.

Fig. 1.

A view of the anterior surface of the upper part of the right *femur, taken from the subject, of Mr. Field's case. In this figure is seen the natural direction of the neck. A part of the pelvic and trochanteral portions of the neck having been absorbed, the fractured surfaces could not be brought into contact at every part, but as there is a portion of the investing membranes left entire, the proper position of the head could not be mistaken.*

a, The head of the bone, with its round ligament attached.

b, The trochanter major.

c, The trochanter minor.

d, The shaft of the bone.

e, *e*, The capsular ligament; a portion of which is removed, in order to show the anterior part of the neck more effectually.

f, *f*, The line of fracture.

Fig. 2.

A view of the anterior surface of the upper part of the left *femur, taken from the same subject.*

a, The head of the bone.

b, The trochanter major.

c, A part of the trochanteral portion of the neck.

d, The capsular ligament turned back.

e, The shaft of the bone.

f, The neck rendered smooth by the action of the tendon of the psoas magnus and iliacus internus.

Fig. 3.

A view of the upper and posterior part of the same bone.

a, Part of the shell of the upper surface of the cervix.

b, The head of the bone.

c, c, c, Strong adventitious ligaments running from the inner surface of the capsule to the pelvic portion of the bone, into which they are firmly inserted.

d, The trochanter minor.

e, The trochanter major.

f, *f*, The capsular ligament cut and turned back over the trochanter major.

g, A bit of bougie separating a portion of adventitious ligament from the capsule of the joint.

Fig. 4.

Represents the internal surface of the same bone, made by a perpendicular section of the wet preparation through the head, neck, large trochanter, and capsular ligament.

a, The shell of the neck at the upper and lower part of the trochanteral portion, pointed out by the uninterrupted lines. These parts appear to be of their usual density, and show the direction and thickness of the cervix.

b, The head of the bone, excavated and receiving, near its centre, the lower part of the shell of the neck. The head is seen depressed towards the trochanter minor, *c*, which it nearly touches, and is firmly united to the trochanteral portion of the neck by osseous matter which has become cancellated.

d, d, The capsular ligament opened and turned back over the trochanter major and minor.

e, The trochanter major.

f, Strong ligamentous band running from the neck of the bone, close to its junction with the head, to the capsular ligament, into which it was inserted.

g, g, The apparent line of fracture.

PLATE. IV.

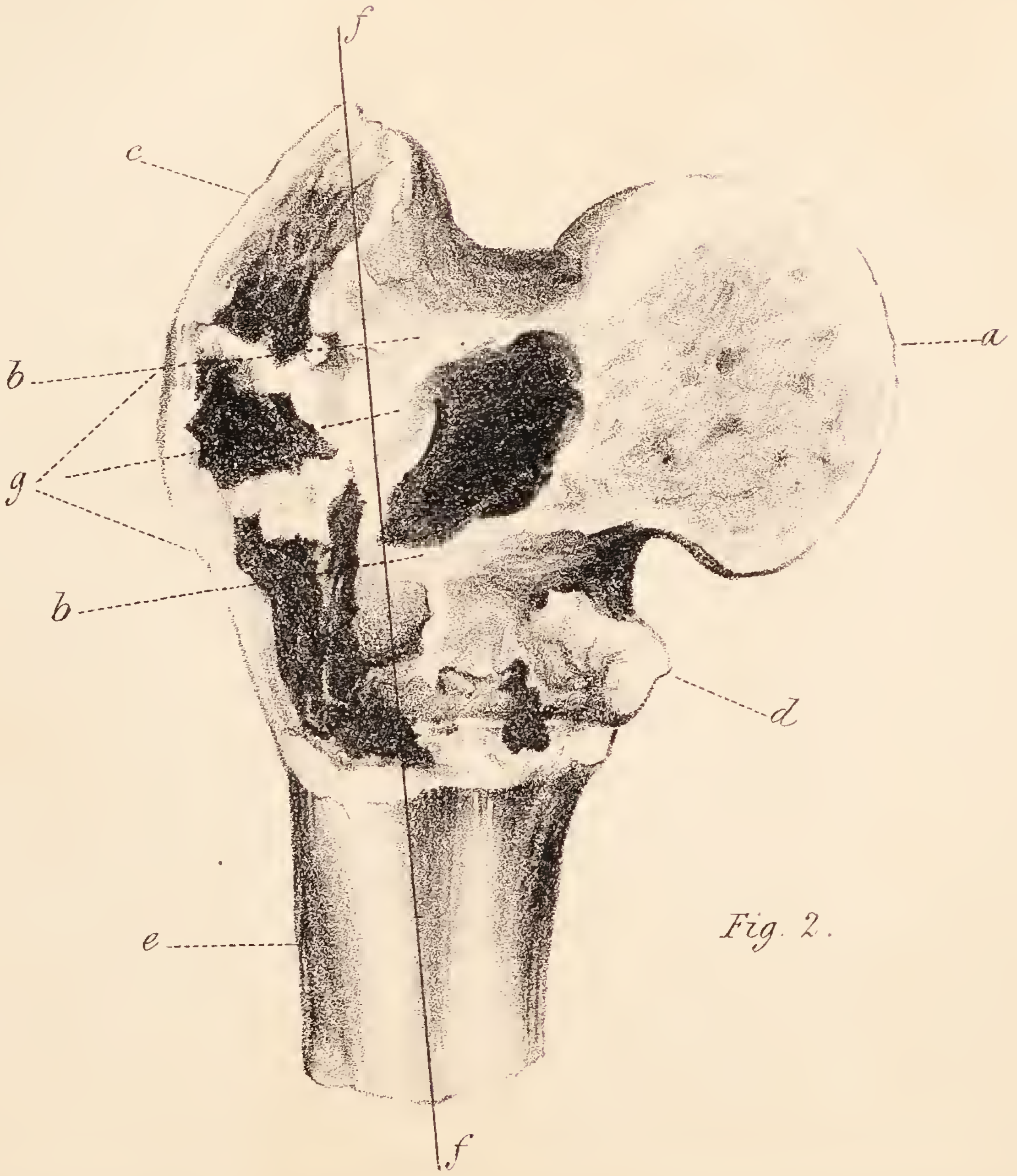


Fig. 2.

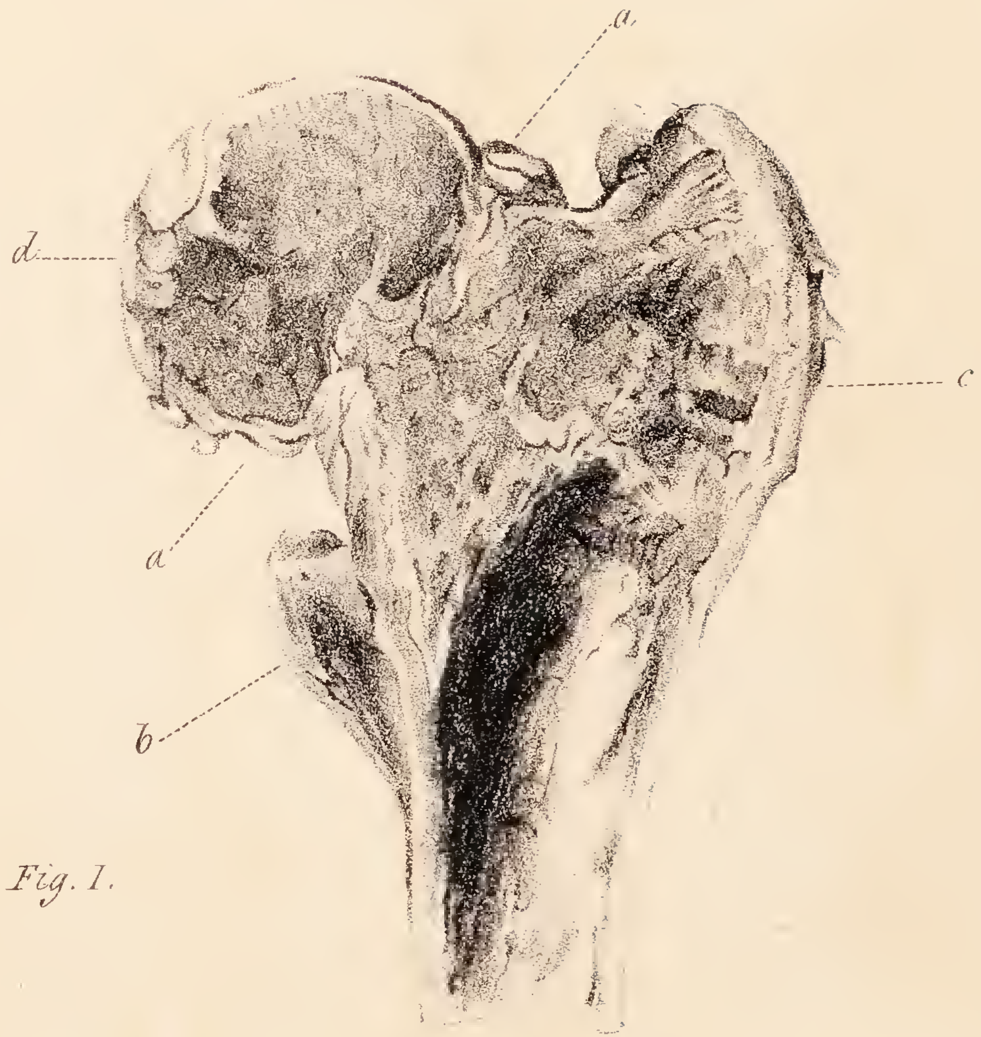


Fig. 1.

PLATE IV.

Fig. 1.

A section of the upper part of a femur in Mr. Langstaff's collection, showing a fracture of the cervix closely united by ligament, and the neck of the bone considerably absorbed.

The patient lived only six months after the accident, and the limb was shortened one inch and a half.

a, a, The line of union.
b, The trochanter minor.
c, The trochanter major.
d, The head of the bone somewhat excavated and receiving the lower part of the shell of the neck into the concavity.

Fig. 2.

A section of the head, neck, and trochanters of a femur, which had been fractured at the base of the neck; showing the neck of the bone driven into the cancelled structure of the trochanter major, where it is firmly united by bone.

This preparation was in Mr. Green's collection, who allowed me to take the drawing.

a, The head of the bone.
b, *b*, The shell of the neck.
c, The trochanter major.
d, The trochanter minor.
e, An undivided portion of the shaft of the bone.
f, *f*, The line of union.
g, Holes in the cancellated structure of the neck and trochanter major.

PLATE. V.

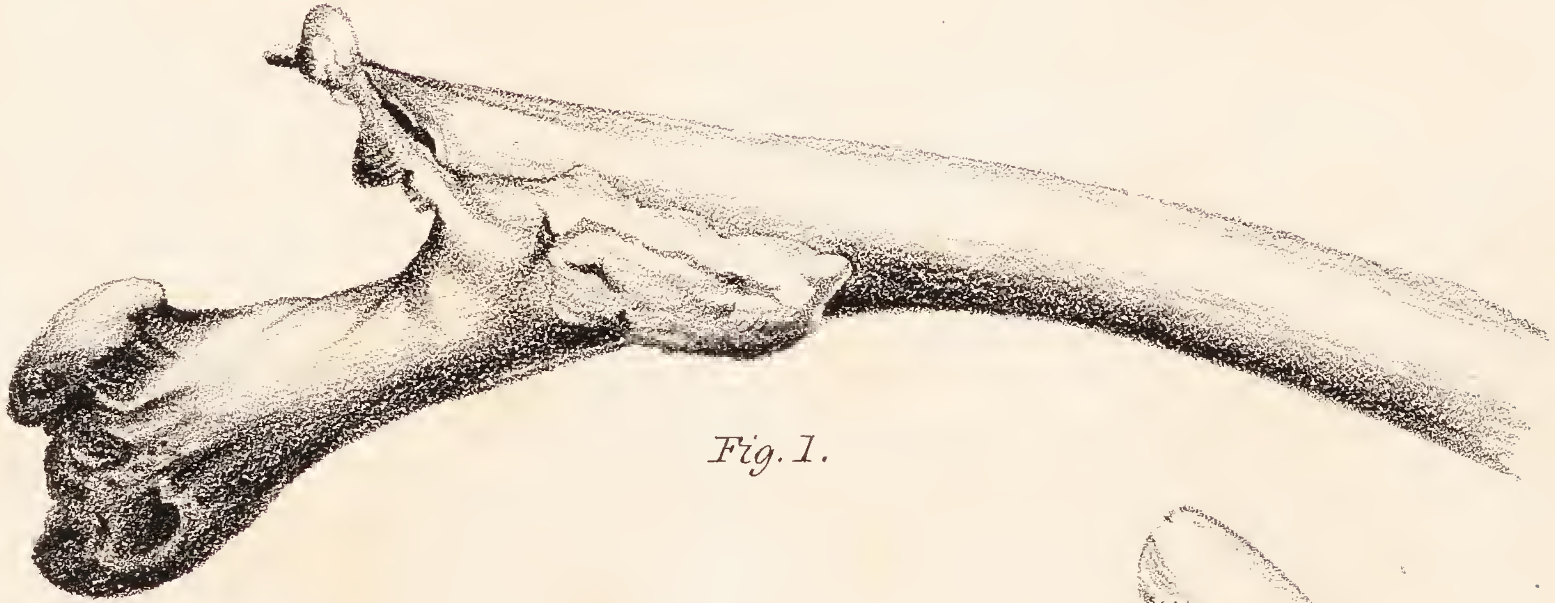


Fig. 1.

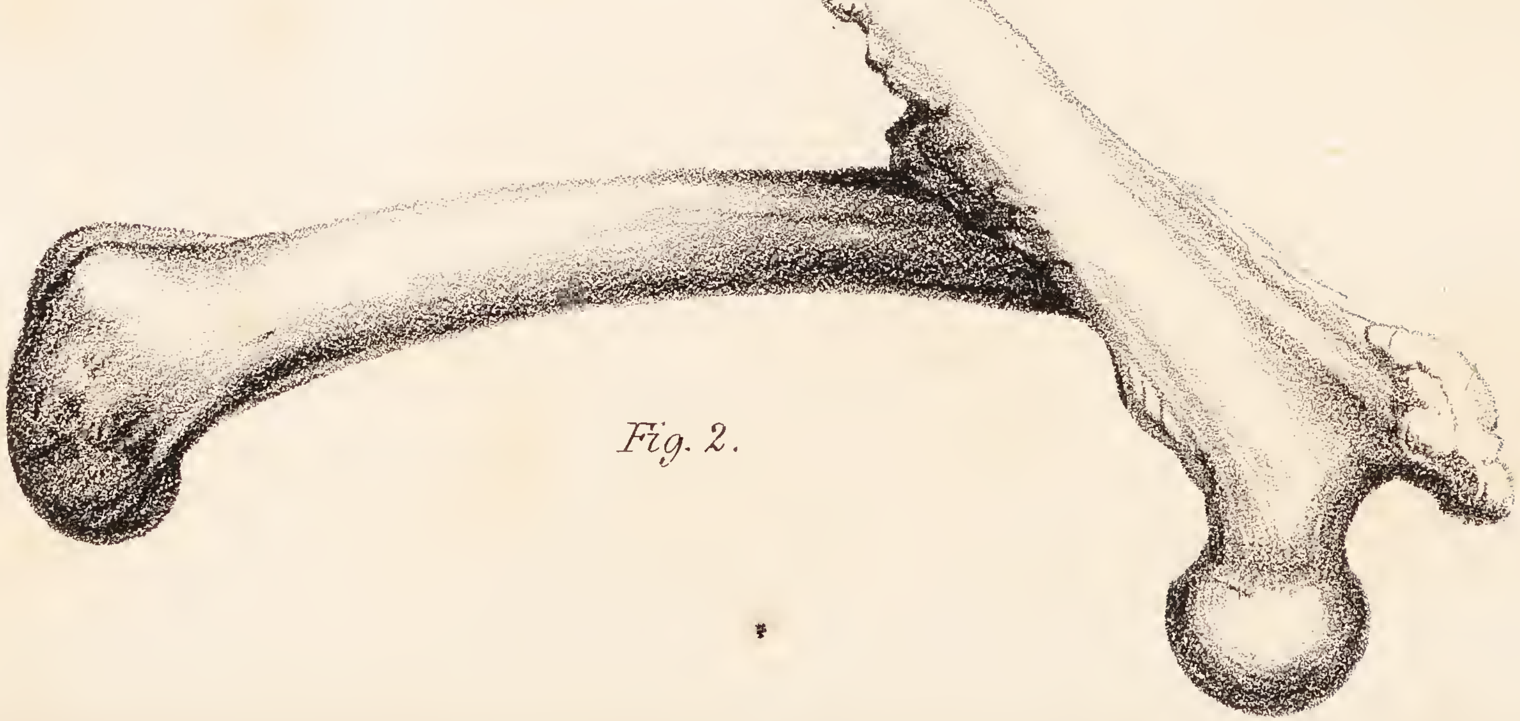


Fig. 2.

PLATE V.

Fig. 1.

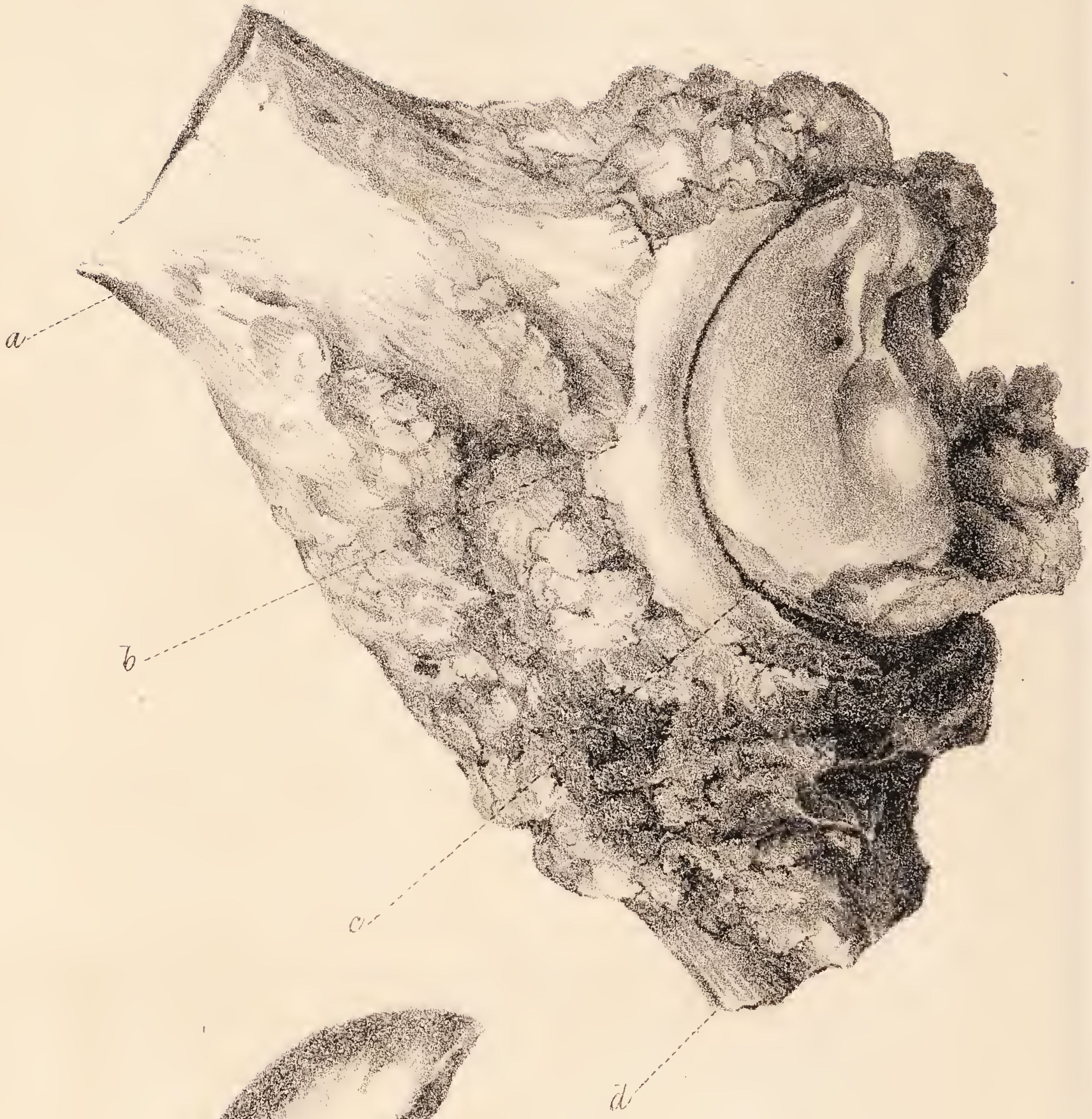
Shews the kind of deformity which takes place in fractures of the thigh, a little below the trochanter minor, when the fracture extends through the bone obliquely, downward and backward. The lower portion of the bone is retracted along the anterior surface of the upper portion, and firmly united to it by callus; a part of which is seen curiously deposited, forming a hook-like process over the sharp projecting end of the lower portion of the bone. The drawing represents the appearance of the outer side of the bone, the head of which had been absorbed, apparently, from scrophulous disease.

Fig. 2.

Represents the kind of deformity which is observed after fractures of the thigh, a little below the trochanter minor, when the fracture extends through the bone downward and forward. The upper portion is bent upon the pelvis and abducted; and the lower portion is *retracted beneath it, and to the outer side, where it is firmly united by callus near the trochanter minor.*

The preparation from which the figures in this plate were taken, was also in Mr. Green's collection.

Fig. 1



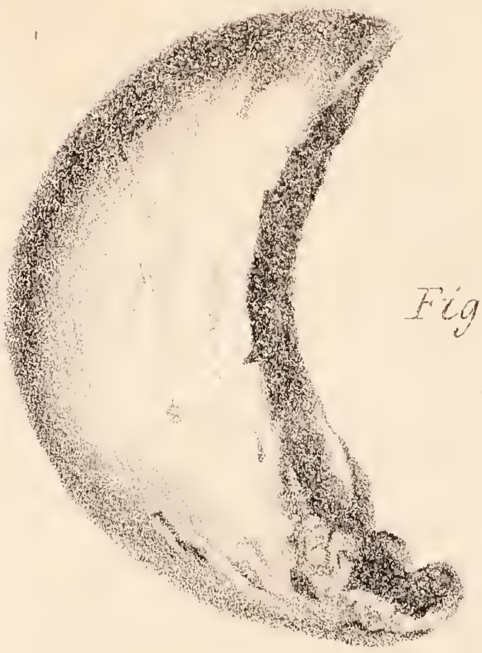


Fig. 2.

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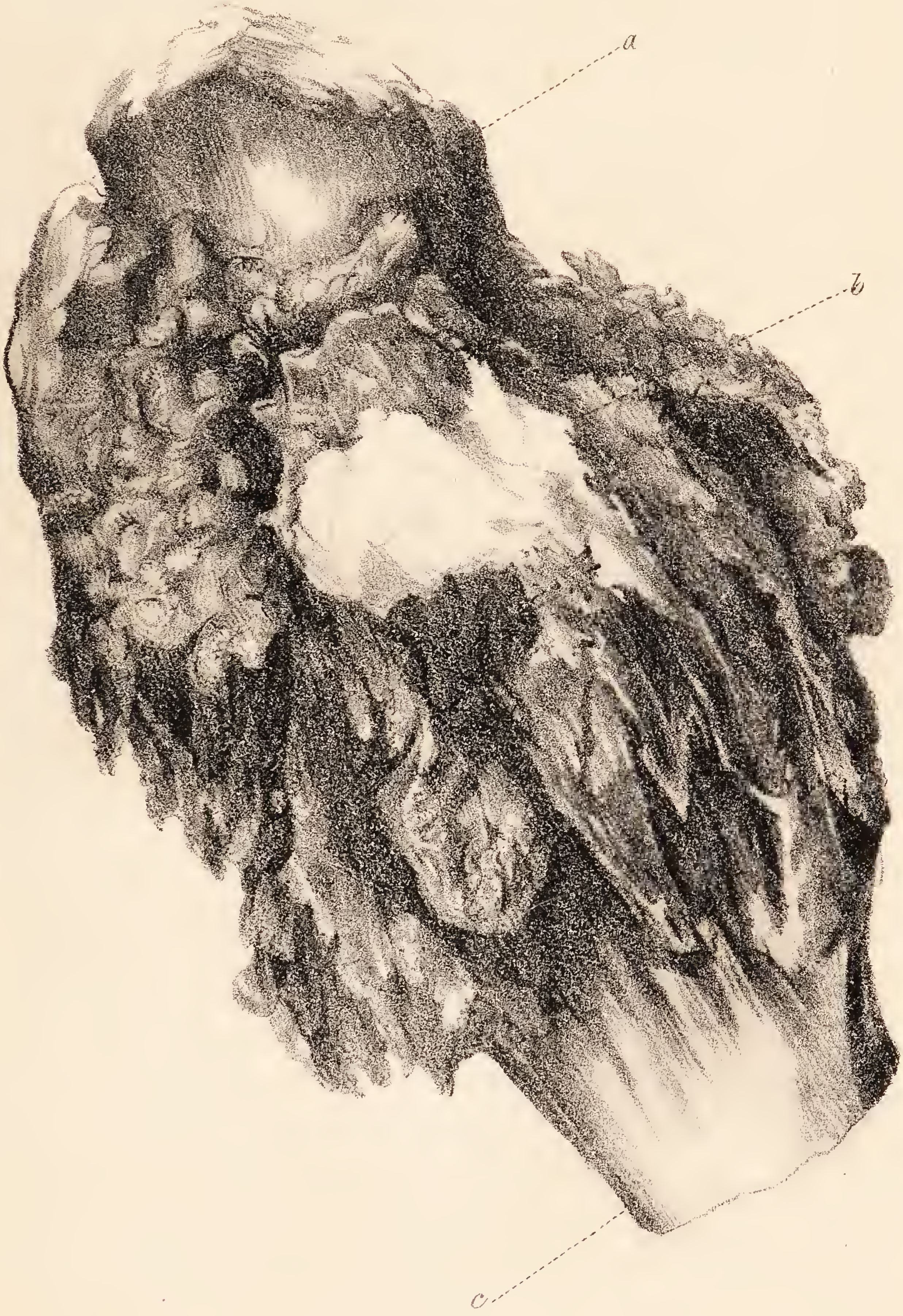
VII.

Fig. 3.



efevre, Newman St.

PLATE VII.

Contains representations of parts taken from a young horse, which was rendered useless by an injury received in the hip-joint about fifteen months before it was killed. On inspection, the neck of the femur was found fractured close to the head. The fracture was of the loose kind, allowing the fractured surfaces to move freely upon one another. The preparation is important inasmuch as it shows that the irritation occasioned by friction has caused the same changes to be produced in the upper edge of the acetabulum, the fractured surface of the pelvic portion, and also in the fractured surface of the trochanteral portion of the femur; namely, absorption and interstitial deposition, by which the surfaces are rendered smooth and, in some parts, dense like ivory. The ivory appearance, however, presented by the altered edge of the acetabulum, is more universal than that of either of the portions of the femur. This might be attributed to the difference in the original structure of the bone, which is much less cancellated at this part than the neck of the femur. The ivory appearance observed in the opposing surfaces of the pelvic and trochanteral portions of the femur is much the same; if there be any dif-

ference it is in favour of the pelvic *portion. The drawings were taken after the bones were freed from the soft parts by maceration.*

Fig. 1.

A view of a portion of the pelvis, having a large quantity of osseous matter deposited in irregular masses around the acetabulum.

a, The sawn end of the ilium.

b, The altered edge of the acetabulum.

c, The head of the femur resting in the acetabulum.

d, The sawn end of the ischium.

Fig. 2.

Represents the remaining portion of the head of the femur much hollowed out by absorption.

Fig. 3.

A view of the trochanteral portion of the femur covered round the base of the neck with a large quantity of new bone very irregularly deposited.

a, The trochanter major.

b, The remaining portion of the cervix.

c, A portion of the shaft of the bone.